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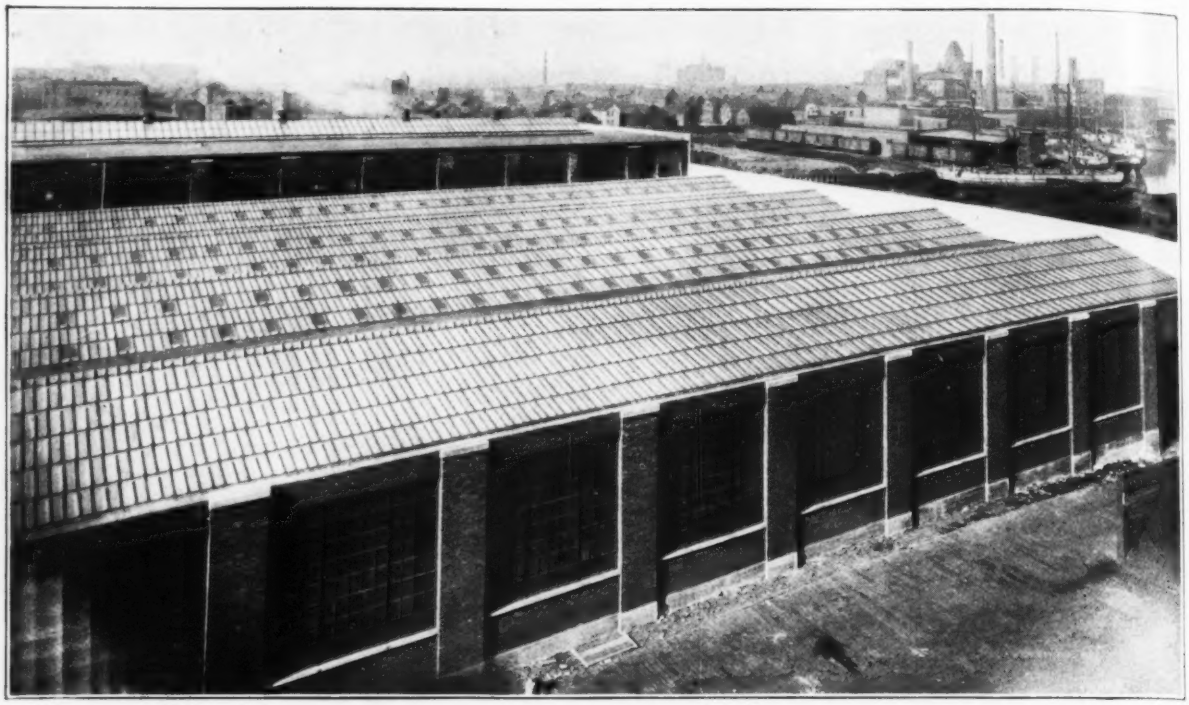
Engineering News-Record

Under the Cathedral-Like Groins of the Baldwin Reservoir at Cleveland

In this issue { **Building the Baldwin Reservoir, a Wide-Span, High Groined Arch Structure—Co-operation Between Railroad and Motor Truck, by W. H. Lyford—Bond Issues for Roads, by J. C. Finch**



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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Highway Research Council

CONFIDENCE in the purpose and opportunities of the Advisory Board on Highway Research is strengthened by the proceedings of the annual meeting held last week under the auspices of the National Research Council in Washington. With limited funds for the director's office and practically no money for committee expenses a substantial volume of work has been accomplished in a year. Standing committees on economics, structural design, materials, traffic, maintenance and finance have been created and are functioning. There has been compiled and published a census of highway research activities in the United States. Few engineers will have realized that there are now under way in field and laboratory 479 separate research studies in highway engineering. The census locates and outlines the nature of each of these investigations. With these concrete accomplishments there is clear evidence that the board is finding its work. The fact is quite as evident in less tangible ways. Its committees in a year have proceeded far in analyzing their fields of effort and in formulating programs of action. Their ideas have crystallized and taken positive shape. They know what they have to do. They are ready in every respect except that of working funds. These have to be created. A sum of $20,000 is estimated to be sufficient and the industries concerned in highway development should find means to provide it.

A Naïve Competition

IF THE mayor of Boston is interested in activating the minds of the students of the Massachusetts Institute of Technology, or even desirous of testing out the type of instruction that admirable school gives, his prize offer noted on another page is a worthy enterprise. If, on the other hand, he is honestly seeking a solution of what the Boston official *City Record* calls "civic problems which have baffled succeeding generations at City Hall" he is going about it in a curious way. Traffic, the increasing bugbear of city life; street cleaning, effective and cheap; odor and nuisance reduction from city industries and finally, fire-proofing of structural steel—these four problems are indeed troublesome ones. Toward their solution is going continuously the best effort of engineering talent the country over. If the young men at "Tech" succeed in contributing to their solution anything so novel and worthwhile as to warrant the city in purchasing the scheme or proposal and putting it into use not only will it be a great testimonial to the student and to his "Alma Mater" but the city will be getting a good deal for its $500.

Fighting the Marine Borer

WHEN man sets out to conquer some natural enemy he generally succeeds. It takes time but in the end he wins. Witness the successive subjection of the wild animals and the gradual, but no less impressive, subjection of the dangerous animalculæ. Lion and typhoid germ both retreat before civilization. There is every hope, then, that sooner or later we shall defeat that persistent and expensive enemy, the marine borer, especially since now there has begun an organized study of its nature and habits. The investigation under the auspices of the National Research Council is now taking on tangible form, as the statement of its progress on p. 941 of this issue shows. While as yet there is no remedy put forth, there is evidence of a groundwork of study which promises a wealth of hitherto unknown facts. On the basis of these facts as to species, occurrence, and habits there will undoubtedly develop some suggestions or principles which will save many thousands of dollars now destroyed by the omnivorous marine worms and bugs.

Railroads and Motor Trucks

CO-OPERATION of railway and highway transport is discussed in an inspiring manner in the address by W. H. Lyford, which is published on p. 933. As a railway executive, Mr. Lyford sees no rivalry between the railway and the vehicle which travels the public roads. Complete transportation, that is carriage from the premises of the producer to the premises of the consumer, he points out can be accomplished only by the agency of the railway and the highway working in conjunction. Each agency has an economic field in which it excels the other. Short hauls of less than carload freight and collection and delivery of freight are particularly the task of highway transport. On the contrary long hauls of carload freight are obviously the task of the railways. Operated in co-ordination the two systems of transport give complete transportation service to the public. It is this conception of railway and highway transport as companion agencies for performing a complete industrial service which is inspiring and gives the address by Mr. Lyford a real constructive value. Incidentally some of the specific applications of highway transport to railway service which are recorded deserve the most serious attention. They suggest, if not a complete solution, at least a way for ameliorating the ever-pressing difficulty of railway terminal management.

"Criminal" Engineering

THOUGH unconsciously given, no more apt commentary on a widely held attitude toward engineering could be conceived than that contained in a recent widely circulated news story stating that fifteen prisoners in a Pennsylvania county jail are to "take up" engineering. The course was offered by the extension division of the state college and the textbooks were donated by one of that species of uplift worker who makes penal institutions his stamping ground. To a certain type of mind engineering is acquirable through six months of correspondence school study

which may or may not be continuous, such a course to be punctuated by summer surveying junkets. Inasmuch as the culprits (in the case at point) desiring "engineering" are inmates of a county jail, they are doubtless first offenders more or less ashamed of their situation and eager for a desire to learn honest means of self-support. Again, their terms of incarceration must be short, else they would be in the state's prison. So one is led to conclude the course is not one in engineering, but the most rudimentary surveying. It is inconceivable that a group of 15-year old minds should be fed upon anything but elementals. Why, then, contemn a profession by intimating that the acquisition of its principles is no weightier a task, mentally, than learning to pick a lock or blow a safe! How silly that same news item would have sounded had the law or medicine been substituted for engineering! And yet, a "stake-artist" is no more an engineer than is a hospital orderly a physician.

Seasonal Road Contracting

SEASONAL letting of contracts is rapidly disappearing in highway practice. A number of states continue to bunch their road lettings into three months in the spring and to limit the work contracted for to the mileage that can be completed in a season, but more commonly bids are being asked and contracts are being let the year around. This changed practice perhaps explains in a measure why this fall a campaign for fall letting of road contracts has not been in evidence. There is a more significant reason, however, in the fact that while letting highway contracts has in large measure ceased to be confined to a few spring months, highway construction is yet an intensely seasonal operation. It is this practice which caused the substantial failure a year ago of the drive to let fall contracts. The contracts were let but construction did not begin until about the usual time in the following spring despite the fact that it was urged by the federal government as a necessary measure for reducing unemployment during the winter. Late season contracts, while they distribute the planning work of the highway department over the year and give contractors more time for ordering equipment and getting ready for spring operations, will not change the time of beginning work nor extend the season of actual construction over more months unless means are developed for doing work in cold weather. This is true even for the task of accumulating construction material.

Waste or Speed?

THE long heralded attack on the contractors who operated under the Construction Division of the Army during the war has apparently begun. The government has sued four of the cantonment contractors to recover millions of dollars which the Attorney General says were wilfully wasted and vague hints are made that this is only the beginning of an effort to recover millions more and possibly to prosecute criminally those responsible.

No one over 21 years old needs to be reminded that in the war preparation of the summer of 1917 waste and extravagance ran riot. We were but newly entered upon a war for which only the slightest preparation had been made. Shelter and equipment had to be supplied for millions of men, supplied in the greatest of haste and in quantities beyond any scale then known or even comprehended. There was no time for the orderly development of production, the step by step forward which guarantees excellence and economy in normal business. Production, quantity production, immediate production, was the need and everything else went by the board to get it.

Cantonment construction was no exception. In fact, coming almost the first of the war expenditures it was probably the best example of feverish haste without regard to considerations of cost. Possibly in this haste more money was wasted than even the imperative demands of war warranted; possibly some individuals profited overmuch. If they did they should be punished, but the prosecutor who tries them and the judge or jury who judges them must be careful to reconstruct the scene. It is not fair to apply the calm standards of peace to the rush and hysteria of a beginning war. Wilful diversion of funds or intentional extravagance will be mighty hard to distinguish through the haze of five years from the honest drive for faster and faster construction regardless of what such speed would cost.

And then, too, will the government attempt to particularize in its search for profiteering? Will it look into the political machinations in that torrid Washington June of 1917, when senators and governors pulled unseen wires leading to the selection of cantonment towns? Will it search out the petty extravagances of army officers who called up New Orleans and Pensacola as though they were on inside phones? Will they denounce that vast body of floating labor which wandered from job to job seeking still higher wages and less work and which cost the people of this country many millions more than could possibly have been stolen by unscrupulous contractors? These are all part of the high cost of war and an equal part with waste and extravagance in construction work.

After all it will be a good thing to get one of these suits brought to court. There have been enough ugly rumors since the war about contractor profiteering to make it desirable to have the matter settled once for all, to have brought before the cold impartiality of a court the facts surrounding one of the big war construction jobs, to have balanced against the wastes, big and little, the magnitude of the impossible things accomplished, to restore if possible the atmosphere of a cantonment under way, with it successes set against its failures. If after such a calm and balanced statement of conditions and facts the evidence is against the contractors and they are made to return the huge sums demanded we will accept the government's contention of fraud and deception. From the facts as we know them, however, we believe the Department of Justice is conducting an unfair campaign.

Twenty Years of Service

THE American public takes it as axiomatic that there must be co-operation in industry, that the best service to the consumer cannot be secured until manufacturers and distributors, out of their long experience, have agreed upon the broad policies essential to the stability of the industry. Consequently, associations for co-operative effort are found in almost every line. To be an outstanding leader among such associations, to be regarded as a model for industrial co-operative effort is indeed a proud distinction. And yet that distinction, accorded ungrudgingly by

business men generally, has been achieved by the Portland Cement Association, which at its meeting in Chicago last week celebrated its twentieth anniversary.

Such an achievement, of course, does not come by accident. There are well-defined reasons, and these, if they be understood by other industrial leaders, will make possible a duplication of the Portland Cement Association's unusual success.

The reasons, or factors, can be rather briefly stated:

1. The portland cement industry, through the association, has brought practically all its manufacturers to co-operate in educating the public to the value and uses of its product.

2. Every manufacturer has thus been able to profit by the vision of the leaders of the industry, while contact of leader with leader has broadened even their vision.

3. There has been extraordinary faith in the product —a faith strengthened immeasurably by the technical and experience studies made possible through the co-operative effort.

4. There has been insistence upon adherence to fact —of founding promotion work upon study, experiment, demonstration. At the core the association is an engineering or, it may be better said, a technical organization.

5. The association's personnel has been decidedly superior, a personnel, we say deliberately, unmatched by any other branch—whether single manufacturer or association—of the construction industry. We doubt whether it is matched in any industry.

And, last but by no means least—and this ought to be written in black-faced type of triple size—the individual companies have backed up by most vigorous individual selling effort the educational work of the association. Many manufacturers, given such an educational service, might have restricted their own efforts, counting on the association's work to make the sales. Not so the cement manufacturers. The association's efforts were educating the public, were creating the demand, but it was for them to move the cement from the bins to the jobs. They did their part with extraordinary vigor. They cultivated the seed which the association had sown—and have reaped a bounteous harvest.

To single out for special attention any one of these factors in the association's growth will throw the others into undeserved shadow. All of them were necessary for the big result. But we want to place emphasis on what we regard as the fundamental characteristic of the organization—its engineering or technical nature.

We can conceive of a vigorous propaganda organization astonishing the public for a time by an extraordinarily vigorous promotion campaign. Much smoke can be made by a little fire. But we cannot conceive an educational effort, sustained and broadening and intensifying each year, unless it were built on a solid basis. In this case the basis, because of the character of the product, was engineering fact.

That view has been taken by the leaders of the cement industry. Of the 342 employees of the association more than 200 are trained engineers, and of these no less than 169 are constantly engaged in the field making studies, inspecting work, telling the story of possible uses of the product. The laboratory is a research organization of outstanding ability, with many important contributions to the understanding of concrete to its credit, while the association's co-operation with technical societies has been an indispensable element in the formulation of standards and recommended practices.

With the base secure, a superstructure of vigorous, far-reaching promotion effort would be safely reared.

Of course, its work has not been free from criticism. Even if it were without fault, no organization would be so successful without inviting the attack of competitors. Moreover, it is to be expected that with an enthusiastic personnel there would be at times overstatement, the making of claims which cold reason would not justify in the light of facts. There has been a disposition to defend concrete in season and out, to refuse to admit the plain evidence that in this structure or that there had been concrete failure. Furthermore, there has been, in our judgment, quite a marked indifference toward the improvement of cement itself—an indifference now happily vanishing, as is evidenced by the initiation of a research into the constitution of portland cement. Except for the latter indifference, though, the faults have grown out of faith and enthusiasm, pardonable faults almost inevitable to an organization that does and dares.

As to the success of the association's work little need be said. The figures are eloquent—17,000,000 bbl. shipped in 1902, the first year of the association's life, 110,000,000 bbl. this year; and this year, be it noted, was marked by a practically negligible railroad construction program, restricted building of industrial plants and curtailed farm purchasing power. In the field of its greatest individual success, concrete roads and pavements, the figures are equally eloquent—5,000,000 bbl. in 1914, 22,000,000 in 1921. For this progress the leaders of the industry unanimously give great credit to the association's efforts.

What service the association has rendered the public by its work we leave to the imagination of the reader to estimate. Figures can hardly tell the tale. They must be fantastically large to give any idea of the truth, for the benefits reach to every walk of life—from the million dollar structures of business, of industry, of transportation, down through the conveniences of public services, from which even the humblest profits, and into the small private home and the simple but money-saving concrete devices of the farm. But there are benefits that cannot be estimated in dollars, that minister, for example, to greater safety, as in fire-resistive construction, and to healthful recreation, as in better highways. In ways such as these cement has contributed mightily—increasing immeasurably the debt which the public owes the cement industry. It has been—as every business should be—an institution of public service.

But the end is not yet. The leaders see a future much greater than the past. In fact, they speak rather lightly—but not disparagingly—of the past. To them it is water over the dam. Their eyes are directed ahead —planning ways for more fully educating the public to present uses of cement, developing new uses, arranging through their individual strong sales and distributing organizations and through the building of new mills to supply the coming demand.

Of the association's and the industry's future success there can be no doubt—so long as vision, the solid technical base, and the boundless enthusiasm persist.

Congratulation and long life!

Building the Baldwin Reservoir, Cleveland Water-Works

Mixing Plant Has Duplicate Equipment—Cableway Electrically Operated and Synchronized —Seven-Yard Concrete Bucket and Sixteen-Ton Skips

A COVERED reservoir of reinforced concrete having the remarkable lateral dimensions of 1,035 x 551 ft. and a height of 39 ft. is nearing completion for the water-works of Cleveland, Ohio. The area and height and the volume of concrete, 104,100 cu.yd., make this perhaps the largest covered reservoir in America. Because of these large dimensions, the thick and high columns and the unusual spans of the groined arches of the roof, the construction task has been correspondingly unusual and the contractor has developed a highly improved plant for his operations. In particular he has demonstrated that the mobility of the cableway reaches considerably beyond the limits that are ordinarily assigned to it as a construction tool.

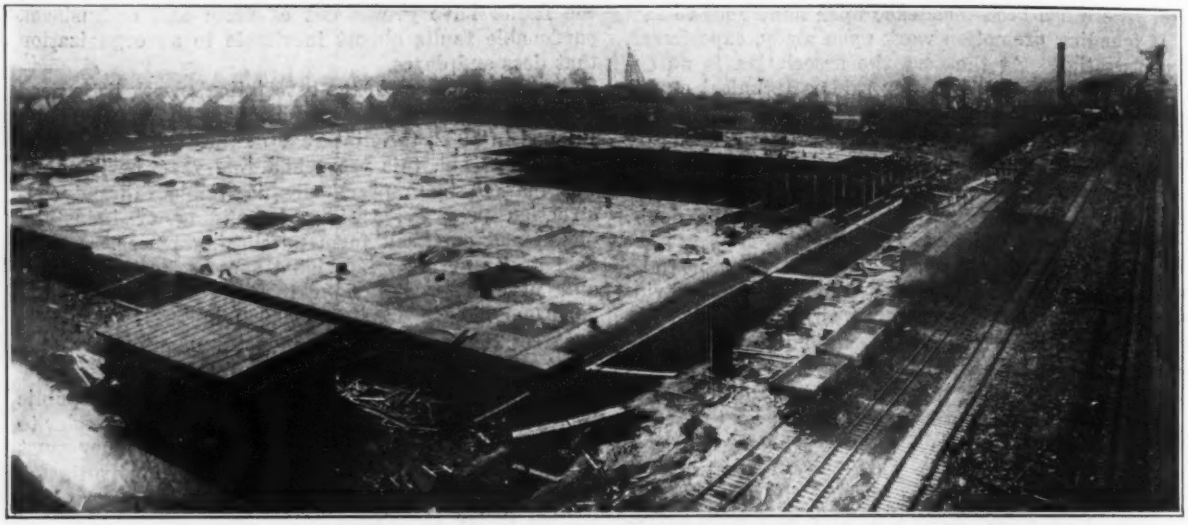

FIG. 1—ROOF VIEW OF BALDWIN RESERVOIR
Each half of the reservoir requires a roof approximately 500 ft. square consisting of 1,104 groined arch panels 20 ft. square on columns nearly 35 ft. high

The new reservoir for Cleveland is known as the Baldwin Reservoir and is a part of the new filtration works located just east of the old Fairmount reservoir. In fact the Fairmount reservoir, with its two basins of 80,448,400 gal. combined capacity, will be the receiving basin for the new filtration works. These comprise a chemical house, mixing flumes, coagulation basins and a clear water reservoir, which is the Baldwin reservoir that is being described. The diagram plan, Fig. 2, shows the relative locations of the several units. With mention that the Baldwin reservoir was planned, and indeed partly excavated, as a storage reservoir and its dimensions were not changed when it was made a unit of the new filter plant, further reference to its functions as a part of this development may be omitted.

Structurally, and also as a construction problem, the governing factor of the new reservoir is its size. The large lateral dimensions give an enormous roof area and the depth of the basin gives a great height of column. The views, Fig. 1 showing the roof area of half the reservoir, the smallest unit embraced by walls, and, Fig. 3 showing the forest of columns, nearly 35 ft. in clear height, vision the situation fairly well. Actual lateral dimensions are given by the plan, Fig. 4. Substantially there are between walls two 500-ft. squares of roof each consisting of 1,104 groined-arch panels supported by 1,196 columns, 30 in. in diameter and 34½ ft. high from footing level to the springing line of the arches.

General Structural Design—A brief explanation of the main operating functions of the reservoir helps in understanding the structural elements. Water from the filters enters a flume hung to the north wall of the reservoir 21 ft. above the floor. Wier notches in the front wall of the flume deliver the water into the two basins across which it flows and enters two conduits, one from each basin, leading to the gate house where an elaborate set of valves turns it into the distribution system. One of the outflow conduits is a box-structure in the angle of the south wall and the floor, and the other is within the wall, with its bottom at floor level. Admission to both conduits is through a row of orifices so proportioned that the rate of admission is uniform the whole length of the conduits. In the same manner the flow into the reservoir from the flume is kept at a uniform rate throughout its length. Briefly, careful thought has been given in designing both inlets and outlets to ensure an even, steady current in the reservoir water and thus eliminate surging and stagnant corners.

Wall design was modified to some extent by the requirements for interior conduits and by the fact that the excavation made originally, required the wall to be thickened at places, but generally the outside walls are of the ordinary abutment-wall type. A section of the division wall between basins is shown by Fig. 5. It is a sturdy section heavily reinforced for full head on one side only, although normally this condition of loading will not exist. The design calls for the construction

of the walls in two lifts, with keyed construction joints, and for vertical expansion joints about 60 ft. apart. The vertical joints are keyed and have the copper-strip water-stop arrangement shown in Fig. 6.

As the reservoir is founded on shale rock the floor design called for a sub-floor, to level up the rock bottom, and a 9-in. plain concrete slab with joints dividing it into squares corresponding to the panel between four columns and also with joints between it and the column base. Nominally the sub-floor was 3 in. thick, but due to the rough breaking of the shale ledge it averaged perhaps more nearly a foot thick. The floor has a very slight fall, 1½ ft., from each wall toward the middle as indicated in Fig. 4. The outstanding feature of the floor design is that it is not only divided by expansion joints into sections about 20 ft. square but expansion joints separate it from all vertical elements of the structure, such as walls and columns. These joints reach to the bottom of the 9-in. slab, are ½ in. wide for the lower 4 in. and then flare out to 1 in. wide at the top, and are filled with bitumen poured hot.

Column and roof-arch design embody no special features aside from those naturally introduced by the size and height of the column and the dimensions of the groined-arch panels, as indicated by Fig. 7. The notable structural feature, considering the roof and its supports as a whole, is the insertion of stiffening walls between the columns of two rows each way across each basin of the reservoir at the middle. This stiffening cross of columns is indicated by Fig. 4 and the construction in detail is shown by Fig. 7. It subdivides the 500-ft. squares between basin walls into quarters making the roof areas carried by unbraced supports only 250 ft. square.

The preceding discussion of the reservoir structure indicates clearly the main features having influence on the construction plant and methods. There were 104,100 cu.yd. of concrete, with 1,750 tons of reinforcing steel, distributed over an area in round figures, 1,135 x 551 ft., as follows:

Walls, footings and floor	69,200	cu.yd.
Roof arches	16,000	" "
Columns	8,500	" "
Valve house, flumes, etc.	10,400	" "

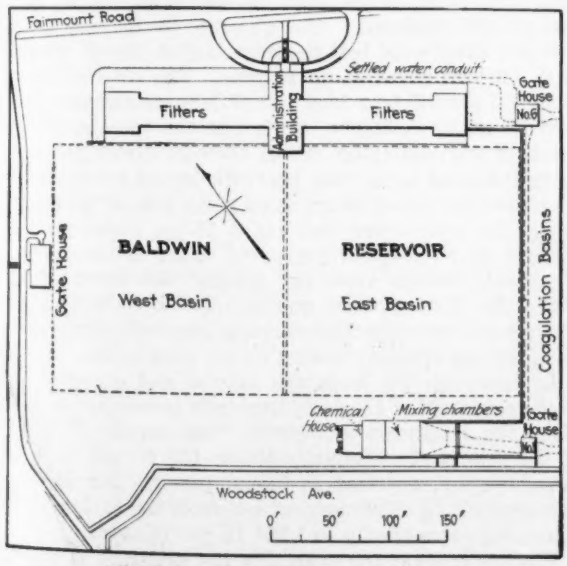

FIG. 2—BALDWIN RESERVOIR IN RELATION TO OTHER FILTER PLANT UNITS

FIG. 3—VISTA OF CONCRETE COLUMNS IN BALDWIN RESERVOIR

Some 2,000 tons of other metal work; 57,000 cu.yd. of excavation, and 215,000 cu.yd. of fill of different sorts completed the materials to be handled. Besides the walls, there had to be built 2,208 groined-arch panels and as many separate sections of floor slab and a total of 1,196 columns. This enumeration indicates the extent of the handling of forms. In brief the large tonnage to be fabricated into many units created a handling problem of exceptional magnitude.

Plant Layout—A very satisfactory track arrangement, as shown by Fig. 8, was possible for bringing in materials and handling the spoil. With this important service arranged the disposition of the remaining units was tributary to the cableway which was selected as the main plant item, with the duty of handling all materials into the structure. As shown, the mixing plant was placed near one end with tracks leading from it along one side of the reservoir so that cars with buckets of concrete could run under the cableway span.

The mixing plant arrangement and dimensions are given by Fig. 8. Aggregates are brought in by cars onto a trestle which parallels the plant on one side and are dumped through the trestle. Three bucket elevators feeding from hoppers under the trestle deliver the sand and crushed stone into the bins. These elevators have a capacity of 75 tons per hour each. On

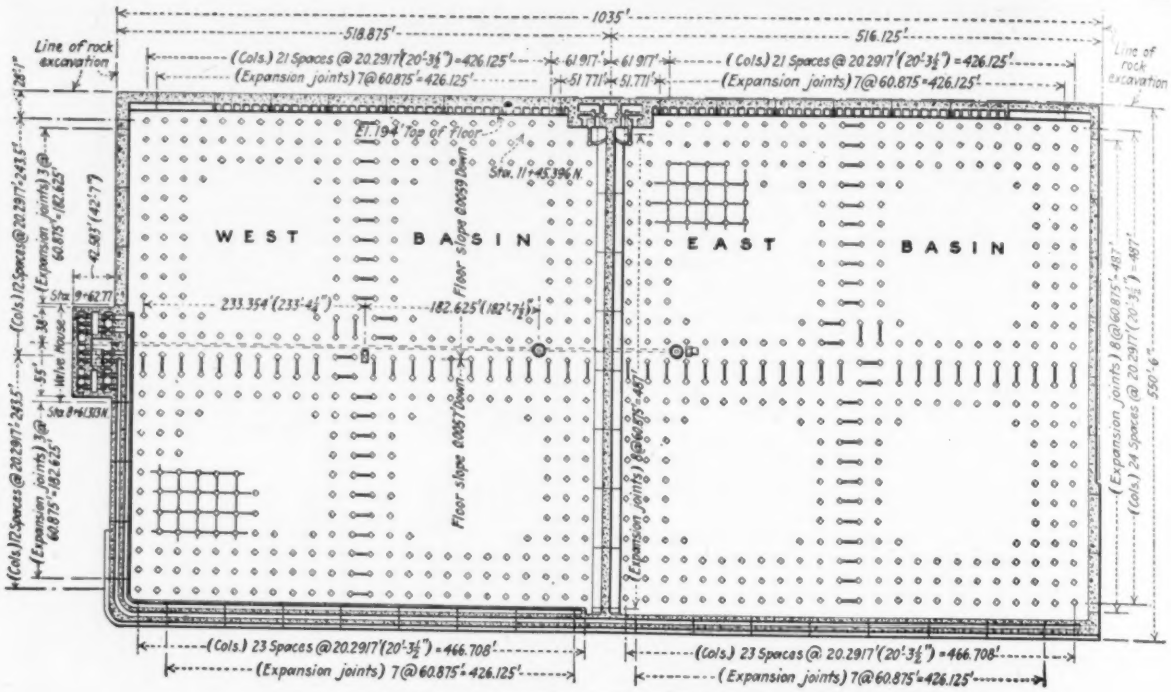

FIG. 4—SECTIONAL PLAN OF BOTTOM OF BALDWIN RESERVOIR

the opposite side of the plant is a track for cement cars. These are unloaded into a cement house which is connected by a belt conveyor with the mixer charging floor. The cement elevator has a capacity of 400 bags per hour.

There are two 28-cu.ft. mixers each served from its own bin compartments and with its individual sand and stone measuring hoppers. Both mixers dump into a central hopper which feeds into the bottom-dump concrete buckets carried on cars. The bin hoppers, measuring hoppers and receiving hopper, as shown by Fig. 8, are steel. In fact all the appliances of the plant are of excellent quality and the plant as a whole is remarkably well outfitted in a mechanical way, practically all operations being mechanical from the stockpiles to the concrete in the buckets on cars. Indeed, from the mixing plant the handling is all mechanical, by cars and then by cableway into the forms.

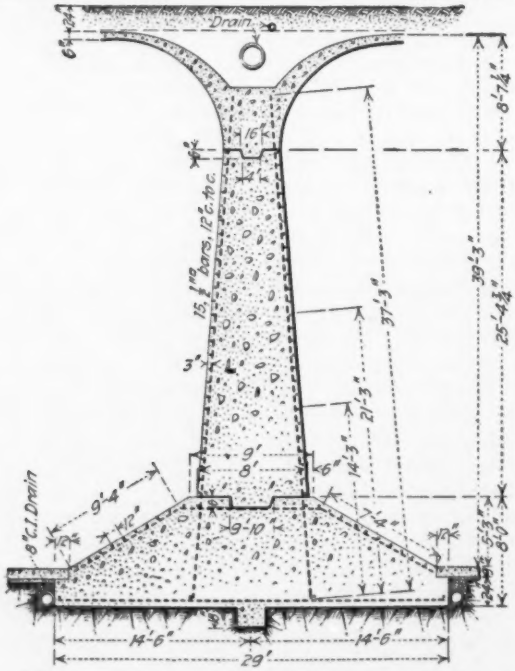

FIG. 5—DIVISION WALL BETWEEN BASINS OF BALDWIN RESERVOIR

Cableway Outfit—An 800-ft. span cableway on 85-ft. timber towers handles excavated material, concrete, reinforcing steel, forms, timber and workmen to or from any point within the rectangle of the reservoir structure. The main cable is 2½ in. in diameter. For rock and earth large skips weighing about 16 tons loaded are employed. The concrete is handled in a 7-cu.yd. shear-gate bottom-dump bucket which weighs with its load about 15 to 16 tons. The cableway was designed for 15 tons load but it has on occasion carried 30 tons. A 300-hp. electric motor operates 52-in. hoisting and conveying drums through direct gears.

As indicated in the view herewith towers are mounted on trucks and travel on tracks on either side of the reservoir. On each tower there is a 75-hp. motor geared directly to an elliptically-grooved drum which carries the steel haulage rope for moving the tower along the track. Both of these moving winches as well as the main hoist are controlled through magnetic controller-panel by one operator located on the head tower.

In operation the loads are hoisted and conveyed at high speeds and at the same time both towers are moved along the trackways as desired. The speeds of travel of the towers are nominally 100 to 150 ft. per minute, but the speed attained in actual practice has seldom exceeded 100 ft. The nominal speeds of the cableway in conveying loads are up to 1,200 ft. per minute.

Electric current for operating the cableway is taken off wires carried on a pole line parallel to the head-tower trackway. It is received at 2,200 volts and is

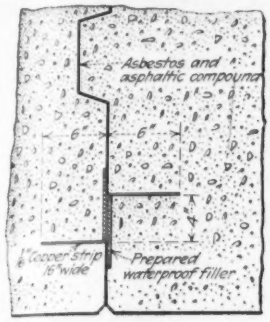

FIG. 6—WATER STOP IN WALL EXPANSION JOINTS

stepped down by a transformer on the head-tower to 440 volts. Near the top of each tower is a cross-arm which carries the conductor and control cables and the light and signal wires. These wires cross the work from tower to tower. From the light-wire high-power incandescent lights, with reflectors, are hung at frequent intervals. Drop wires for signals are also spaced at frequent intervals along the span so that it is easy to signal the operator from almost any part of the operation.

As previously stated this cableway has handled practically all materials—spoil from the excavation, mixed concrete, reinforcing steel and forms—into, from and about the reservoir area. There is not a derrick or gin pole within the reservoir to supplement the cableway in distributing and placing materials.

Concrete Construction—Three classes of concrete are used: (1) A 1:3:5 mixture, with 2½-in. stone, for the wall foundations, 16,500 cu.yd., (2) A 1:3:5 concrete, with 1½-in. stone, for walls, sub-floor and roof, 55,200 cu.yd., and (3) a 1:2:4 concrete, with 1-in. stone, for columns, floor and valve house and flume walls, 22,400 cu.yd.

In placing the concrete, aside from the usual requirements of good practice, attention was given to the location of construction joints and continuity of placing. All walls were built above the footings in two lifts. In the outside walls the first lift went to elevation 211 which made the lower section 19 ft. 9 in. and the second section 18 ft. 3 in. high. In the dividing wall the

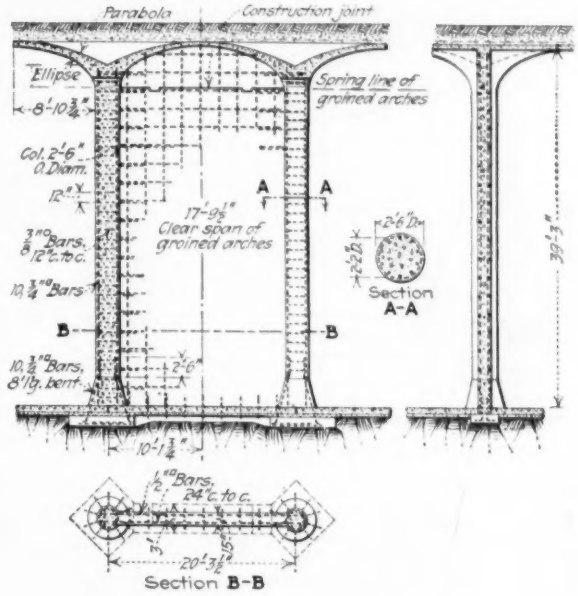

FIG. 7—COLUMN AND ROOF ARCH DESIGN BALDWIN RESERVOIR

first lift went to the top of the spread base as indicated by Fig. 5. Along the walls there was an expansion joint every 60 ft. The walls therefore were concreted in sections 60 ft. long and one lift high, each unit as a single operation. The columns, however, were poured in one operation from footing to spring line. In the groined-arch roof construction joints were limited to the junction plane with the barrel arches and to vertical planes at mid-span.

In the barrel arches construction joints were permitted only over expansion joints in the supporting

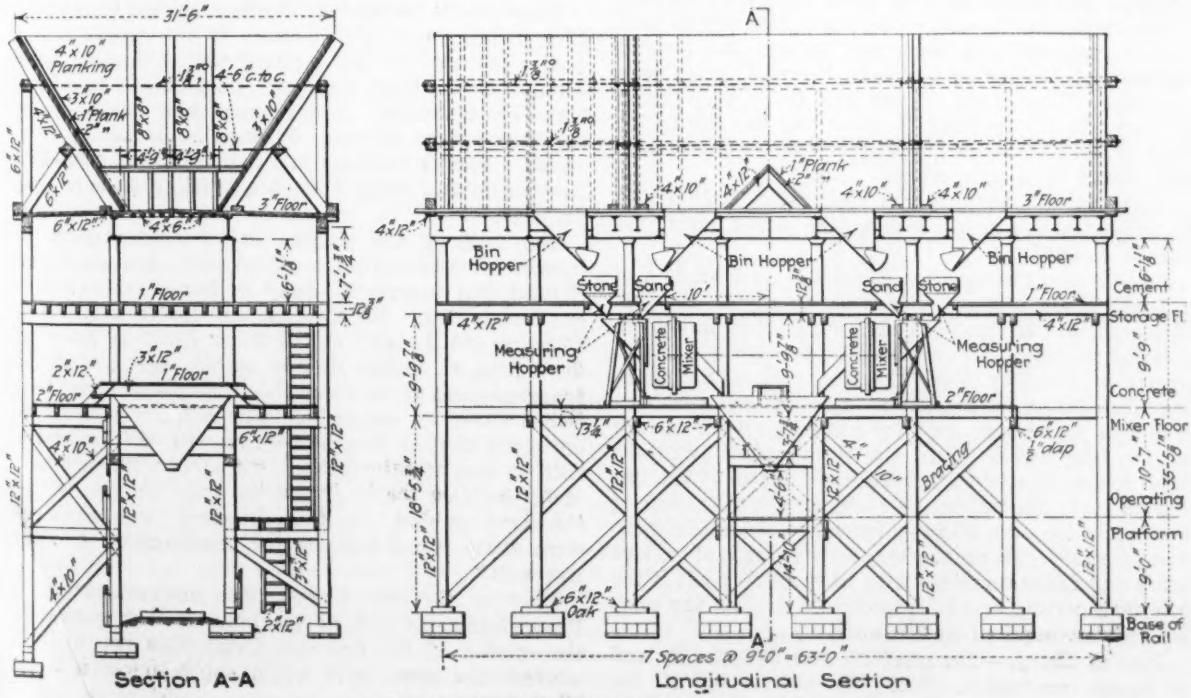

FIG. 8—MIXING PLANT ARRANGEMENT BALDWIN RESERVOIR

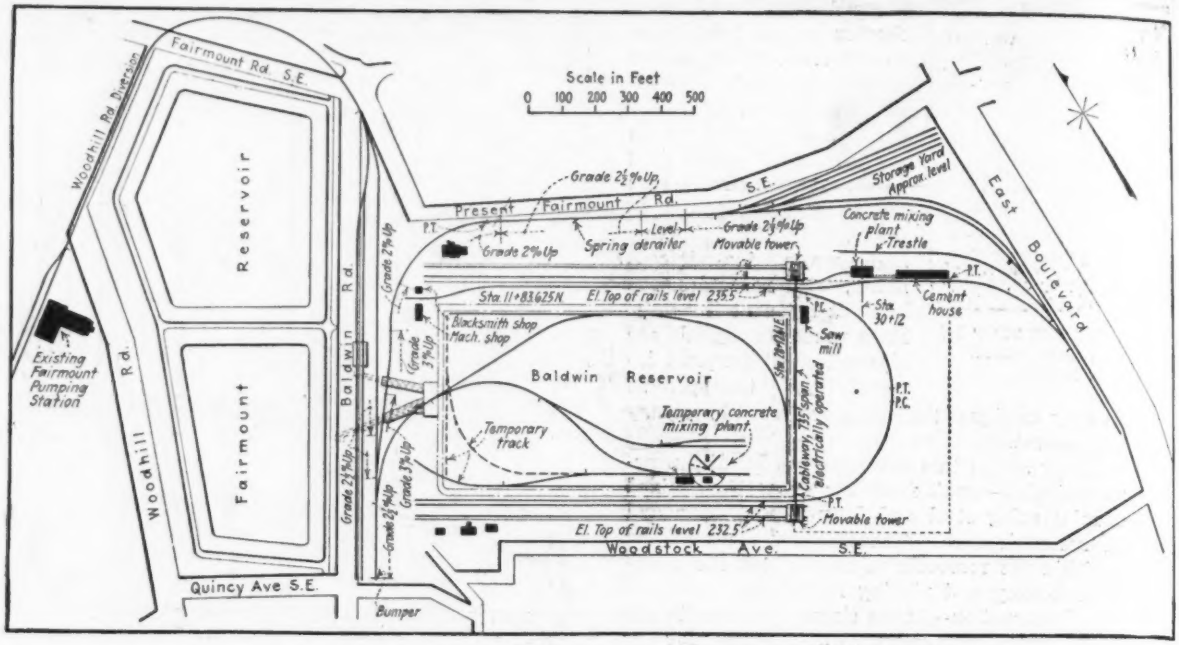

FIG. 9—TRACK AND PLANT LAYOUT FOR BALDWIN RESERVOIR

wall. The floor was poured in alternate sections of one-panel area as previously described. Each unit within the joint limits indicated was invariably concreted as a monolith.

All forms, except the steel forms for the circular columns, are made of wood in large units. The roof unit was a full groined-arch panel form about 20 ft. square. The cableway lifted the wood panel and shifted its position by means of a four-hook sling. For the walls the panels were made 45 ft. long and one-lift high. This required two panels for each 80-ft. section of wall but longer forms coming within any reasonable weight could not be made without being too limber. No unusual methods of bracing or fastening the wall forms were employed. The column forms had to be very firmly anchored to the footings to resist the lift due to the flare of the base section, but otherwise were connected and braced by usual methods.

Progress in concreting has been rapid, from 12,000 to 18,000 cu.yd. a month having been placed during the season of 1922.

Outstanding Construction Features—As a solution of a construction problem the operation at the Baldwin Reservoir in Cleveland is chiefly of interest in demonstrating the mobility of the long-span cableway. In this operation a rather ideal situation existed for cableway installation and operation—a rectangular construction area, with ample room for traveling towers on each of the long sides. With electrical control from the head tower, complete synchronism of travel of the two towers made the cableway a reasonably rapid means of transportation even when movement of the whole outfit was necessary. Its equal adaptability to loads of various kinds and forms combined with its mobility made it the sole transporting and hoisting device, besides the service railway, required on the work.

Men in Charge—The reservoir was designed by and is being constructed under the supervision of the Frazier-Sheal Company, engineers, Cleveland, Ohio. Their resident engineer is H. T. Hammer. This work is being carried on by the Division of Water of the Department of Public Utilities of which A. B. Roberts is director, A. V. Ruggles, commissioner of water, and J. W. Ellms, consulting engineer on water purification. The contractor constructing the reservoir is the Stange-Walsh Construction Co., Cleveland, Ohio.

Damages Due to Party Wall Not Recoverable Is Supreme Court Decision

There can be no recovery for loss incident to removal of a building wall which comes to the property line and is not suitable for a party wall, according to a decision by the U. S. Supreme Court Oct. 23 in a case from Pennsylvania. The opinion was delivered by associate justice Holmes. Edward F. Jacksman, who owned a theater building in Pittsburgh, had sued The Rosenbaum Co., which erected a building on adjoining property.

The wall of the theater had to come down to permit of constructing a party wall, and Jacksman claimed that because of delay he lost a season's rent on the theater. He lost in the courts below. In affirming the decision of the lower court in favor of the defendant, Justice Holmes' opinion agrees with the pronouncement of the Pennsylvania Supreme Court that "when either lot owner builds upon his own property up to the division line, he does so with the knowledge that, in case of the erection of a party wall, that part of his building which encroaches upon the portion of the land subject to the easement will have to come down, if not suitable for incorporation into the new wall."

Much of the case hinged upon ancient custom in Pennsylvania, as well as the laws of that state, and the opinion of the Supreme Court does not indicate whether the same tests would apply to cases in all other states.

Majority and Minority Reports on Columbia Basin Project

Supervisor of Hydraulics for State of Washington Dissents from Opinion of Other Members of Special Board

THE report on the use of the waters of the upper Columbia River by a Board of Engineers appointed at the instance of the Federal Power Commission, is to be printed and will be available for distribution before the end of the year. The printed report will include the minority report submitted by Marvin Chase, the supervisor of hydraulics for the state of Washington. In the minority report vigorous exception is taken to what is alleged to be an effort on the part of the Federal Power Commission to exceed its authority. The majority members of the Board of Engineers point out, however, that it is essential to the Commission's duties in passing upon permits and licenses to follow a well-defined policy for the most efficient use of the resources of a river. The conclusions of the majority members follow:

(1.) Freedom should be given to fullest irrigation expansion in Montana, Idaho and Washington, and no rights should be allowed to accrue to lower interests which would legalize limitation of or interference with irrigation above.

(2.) It is the most important single item to be considered in the uses to be made of Columbia River water above the mouth of Snake River.

(3.) It can be irrigated by gravity from the Clark Fork at Albany Falls or by pumping from the Columbia River at Grand Coulee.

(4.) The Columbia Basin gravity project can be adequately supplied by the aid of storage in Pend Oreille and Priest Lakes in Idaho, conditioned upon maintenance of natural flow from Flathead Lake when needed.

(5.) It can be supplied with practically no shortage, without the aid of storage, with a dam at Grand Coulee about 156 ft. high above low water.

(6.) Information upon which to base a final decision between a gravity and a pumped supply for a Columbia Basin irrigation project is not complete and should be completed. Any decision should take into account the effect upon potential power.

(7.) Pending such decision no permanent rights of storage should be granted in Pend Oreille and Priest Lakes.

(8.) If ultimately the decision is in favor of a Columbia Basin gravity project, storage rights in Pend Oreille and Priest Lakes should be granted to such project, but should be limited to storage of inflow in excess of 7,000 sec.-ft.

(9.) If ultimately the decision is in favor of a Columbia Basin pumping project, storage rights in Pend Oreille and Priest Lakes should be granted to the joint interests of power on the Lower Clark Fork and the Columbia River, subject to limitations contained in Section 1.

(10.) Storage rights in Flathead Lake should be granted to Flathead power interests, subject to fullest development found practicable after complete investigation. Prior to such development rights may be advantageously granted to power interests on Clark Fork subject to conditions protecting ultimate control for Flathead power and natural flow release when needed for the protection of the Columbia Basin project if built on the gravity plan.

(11.) Storage control at Flathead, Pend Oreille and Priest Lakes should be under impartial supervision.

(12.) A permit to develop power at the Grand Coulee site or at any point on the Columbia River as far downstream as the Foster Creek site should not be granted to power interests until it is known that such site will not be needed by the Columbia Basin project. In case the Columbia Basin project shall require a power site for irrigation and power on this stretch of the river, a permit should be granted to it after the best location and height of dam shall have been determined from the project and the public interest.

In his report Mr. Chase concludes that:

(1.) The use of the water of the Columbia River for irrigation is of greater benefit to the people of the United States in general and of the Northwest in particular, than its use for power.

(2.) The published reports of the United States Reclamation Service, and other investigations show that the irrigated lands in the arid portion of Washington yield greater returns per acre and per dollar of capital cost than those elsewhere. This is due to the wonderful fertility of the soil, the exceptional climatic conditions, and the progressiveness of the population in adopting the best methods.

(3.) For these reasons, construction of the officially adopted Columbia Basin Gravity Project, for the irrigation of 1,753,000 acres of arid land in the State of Washington, is a matter of supreme importance to the people of that State. It is in fact a most important national problem.

(4.) The Federal Power Commission, while having no jurisdiction over irrigation, should recognize the superiority of right for irrigation of this vast project, and should grant no power rights to conflict with irrigation development.

(5.) The Columbia River Board has evaded its duty by not considering and recommending an arrangement of power development on the Flathead, Clark Fork, Spokane, and upper Columbia River which would yield the maximum commercial power, near existing and probable markets, subject to the superior use of the waters for irrigation of the greatest possible area.

(6.) The State of Washington having officially adopted the gravity project for the reclamation of the Columbia Basin lands, the Federal Power Commission should not become involved in any controversy as to other possible means of reclamation, but should co-operate with the State to forward the early development of this area, allowing maximum utilization of the water resources of the Columbia River.

Data Concerning Cloudburst Flood at Colorado Springs

Hydraulic Factors Determined From Flood-Line Measurements—Relation Between Cloudburst and Flood

By Paul V. Hodges

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IN THE paper entitled "Floods on Small Streams Caused by Rainfall of the Cloudburst Type," in *Proceedings* of the American Society of Civil Engineers, for May, 1922, the author states that he "believes that if the toll taken annually by these floods were better known, it would attract greater attention to the problem of providing against them, and he takes this opportunity to emphasize the importance of collecting reliable statistics on this subject."

A typical example of a flood of the cloudburst type, which caused much damage to property in and adjacent to Colorado Springs, Colo., occurred on the night of May 27, 1922, as the result of torrential rains above Templeton Gap, five miles northeast of Colorado Springs.

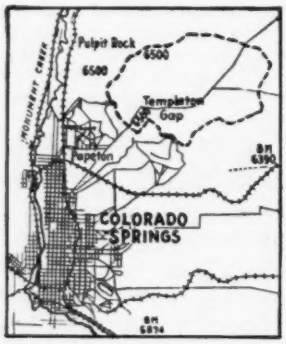
The topography northeast of Colorado Springs is composed of a semicircular range of hills, which rises abruptly and reaches an altitude of more than 6,800 ft. —about 800 ft. higher than Colorado Springs. These hills, whose rocky slopes support little vegetation, except a few coniferous trees and small brush, encircle an oval-shaped basin which has a narrow outlet called Templeton Gap. Dry waterways or gullies of nearly equal length descend from the hills and join a short distance above the gap. For three-fourths of a mile below Templeton Gap there is a deep, well-defined channel which can carry extreme floods, but farther downstream it widens until there is practically no channel.

HYDRAULIC FACTORS DETERMINED FROM FLOOD AT TEMPLETON GAP

Stream	Drainage Area in Sq.Mi.	Topography of Basin	Cross Section Sq.Ft.	Per Cent of Agricultural Land	Slope S Rates	Maximum Discharge Sec. Ft. Total	Maximum Discharge Sec. Ft. per Square Mile	Equivalent Runoff In. per Hr.	Remarks
Templeton Gap	7.1	Steep, rocky slopes and small amount of agricultural land.....	556	20	0.0108	6,120	862	1.34	536-foot stretch: good condition.

Cloudburst and Flood—About 6 p.m. on May 27 heavy, rain-bearing clouds from the southwest passed over Colorado Springs and upon reaching the range of hills were deflected upward until their moisture was condensed and precipitated. The resulting storm lasted from 6 to 9 p.m. over an extensive area north and northeast of Colorado Springs although it was much severer directly above Templeton Gap. Here, a semicircular basin, concave toward the southwest, converged the air currents; and when the moisture was carried up and condensed it fell in a cloudburst which practically covered the drainage area of Templeton Gap and the adjoining area on the north and northeast. At Papeton and Colorado Springs the precipitation was only ½ in., but just above Templeton Gap 7 in. of water was caught in a pail standing in an open space, and farther up towards the hills about 10 in. of hail was reported.

The cloudburst above Templeton Gap caused a flood which reached Papeton about 8:30 p.m. About three-fourths mile above Papeton a railroad trestle is built over the channel. This trestle is 15 ft. high and has earth-fill embankments at each end. These embankments restricted the channel and caused an appreciable pondage above, until they were partially washed out. The pondage was computed to be about 6 acre-ft., and the effect of backwater amounted to about 5 ft. just above the trestle. This stored water, when released, probably increased the flood discharge downstream; but the amount of increase is not known as it would depend on the length of time consumed in washing out the embankments. Below the trestle, where the channel widens and flattens out, the flood was forced to spread out over the fields for about half a mile. Then part of it passed through a railroad culvert and finally escaped down a gulch through Colorado Springs to Fountain Creek, while the other and larger part flowed down over Papeton and flooded some of the streets to a depth of 4 or 5 ft. with swiftly flowing water which washed out fences, barns, streets, and sidewalks. From here it passed on and washed out the Atchison, Topeka & Santa Fe tracks at a point half a mile below Papeton before it escaped into Monument Creek just north of Colorado Springs. Although the area above Templeton Gap is subject to frequent cloudbursts this flood is reported the highest ever experienced—at least since 1880.



SKETCH MAP OF TEMPLETON GAP AND COLORADO SPRINGS

A notable feature of this flood was the mud balls, left in the channel, closely resembling black boulders and of a nearly black clay or gumbo, with stones and pebbles embedded, and ranging from 6 to 30 in. in diameter.

Estimated Maximum Flood Flow—In order to estimate the maximum discharge of this flood five cross-sections about 200 ft. apart were measured, using the high-water marks, in a stretch of channel a short distance above the railroad trestle. When these cross-sections were plotted, however, the two lower sections were found to be influenced by backwater from the trestle and were not used in determining the slope and other hydraulic factors. The channel was fairly smooth and even in this stretch, and a value of 0.030 was given to Kutter's coefficient of roughness and used in computing the quantities in the table of hydraulic factors. The area above Templeton Gap was accurately determined from the Colorado Springs topographic sheet.

Data regarding the duration of the flood are not available, but if it is assumed that an average of one-half of the maximum flow lasted for three hours it would give a volume of 757 acre-ft., or about 2 in. in depth over the drainage area.

Cloudbursts Explained—The following explanation of cloudbursts is taken from United States Geological Survey Water-Supply Paper 487:

> The phenomena called "cloudbursts" are very intense rainfalls of short duration over small areas that are sharply defined. Cloudbursts are common along the eastern slope of the Rocky Mountains wherever canyons have cut deeply into the mountain masses. Each of these canyons acts like a chimney flue in creating a strong, upward draft for the warm and relatively moist air from the plains, which passes up the canyon and reaches an altitude where the temperature becomes low enough to condense the moisture. The upward draft is sufficiently strong to support the moisture for some time after condensation begins, but finally the weight of moisture in the air becomes too great to be longer sustained, and it is precipitated in torrents. Cloudbursts of less violence also occur on the plains.
>
> Coincident with a cloudburst is the other phenomenon of a "wall of water" rushing down the stream.

The above explanation of cloudbursts tends to show a relation between topography and intensity or violence of cloudbursts, whereas the relation between topography and rate of concentration of runoff tends to connect rate of concentration with intensity of cloudburst. In other words, a rush or wall of water flowing down a channel would give the impression that this volume of water was actually dumped on a small area, when in fact the area contributing the runoff may be small or large with the intensity or violence of the so-called cloudburst varying in inverse proportion for similar drainage areas. A precipitation of a certain intensity over one area may be called a cloudburst though the same amount of precipitation over another area would not attract attention.

As the area above Templeton Gap has physiographic features that produce large floods it is said to be subject to frequent cloudbursts. The drainage area is so small that heavy storms practically cover the entire area; and the steep, rocky slopes, covered with little vegetation, are largely impervious and the rains that fall on them run off quickly. The shape of the basin, also, is such that floods from different parts of the area arrive at their junction at the same time and concentrate the flow.

Until more data on intense precipitation and its corresponding runoff are available it is impossible to distinguish the true relationship of cloudbursts and floods.

Standardized Appliances for Irrigation Structures

Designs for Gates, Lifts, Hoists, Radial Gates, Stems, Couplings and Guides as Standardized by the U. S. Reclamation Service

BY J. L. SAVAGE
Designing Engineer, U. S. Reclamation Service

THE designing department in the office of the chief engineer of the U. S. Reclamation Service at Denver, Colo., has recently completed a large number of standard designs of mechanical appliances for use in connection with irrigation structures. These designs embrace the first step in a comprehensive program of standardization work which will ultimately include the preparation of standard designs for all kinds of irrigation structures.

The designs for mechanical appliances were undertaken for the reason that the types, detail dimensions and anchor-bolt layouts for these appliances had to be determined before the structure designs could be made. The standardization of structures is under way at the present time and it is expected that a large number of standard designs will be completed within the next few months.

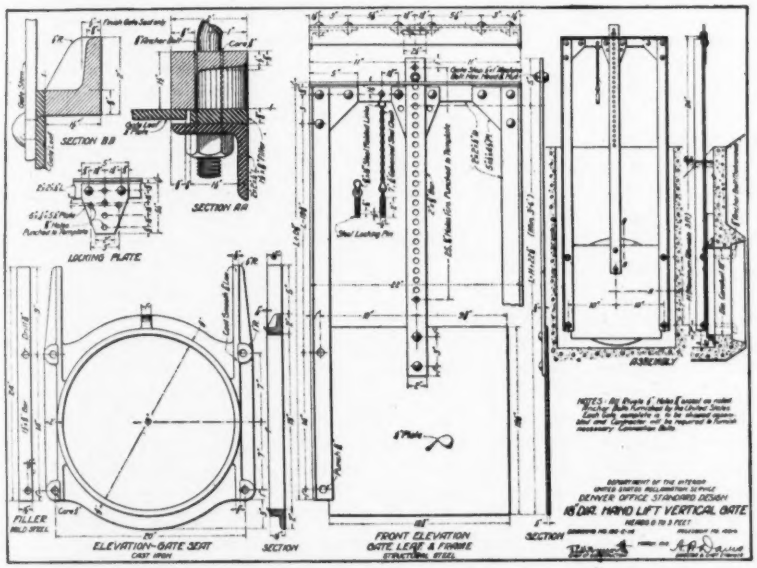


FIG. 1. HAND-LIFT VERTICAL GATE, 18 IN. IN DIAMETER

The mechanical appliances which have been standardized include the following:

Farm and lateral turnout gates.
Handwheel gate lifts for turnout gates.
Cast-iron gates for canal and reservoir outlets.
Gate hoists for cast-iron gates.
Radial gates for canal headworks, checks and wasteways.
Radial gate hoists.
Gate stem couplings and guides.

Farm and Lateral Turnout Gates—The designs for farm and lateral turnout gates include five different types: (1) Vertical gates for circular conduits, Fig. 1; (2) slope gates for circular conduits; (3) vertical gates for rectangular conduits; (4) slope gates for rectangular conduits; (5) vertical gates for rectangular open channels.

Designs have been completed for 93 different sizes of gates of these general types, based on heads grouped as follows: 0 to 3 ft.; 3 to 6 ft. and 6 to 9 ft. The types for conduits consist of structural steel gates and frames combined with cast-iron gate seats. These types are assembled in place on anchor bolts embedded in the concrete turnout structures. The type illustrated in Fig. 2 is made entirely of structural steel. It is fully assembled and riveted up in the shop ready for bolting to the turnout structure.

The simple hand-lift type of gate as illustrated in Fig. 1 is used only in small sizes, 12 to 24 in. in diameter, and under low heads, 0 to 3 ft. Screw lifts are used in all cases where the size of gate or the head on the gate is sufficient to require a mechanical device. The threaded stems for turnout gates are made of mild steel bars which have proved satisfactory and more economical than cold-rolled or turned-steel shafting. The threads on these stems are usually cut in a threading machine and an acme thread of loose fit in the nut is provided. The loose fit is effected by threading the nut $\frac{1}{8}$ in. oversize and by this means the stems are made to work freely in the nuts, irrespective of their condition as regards rust or other coating on the threads.

Handwheel Gate Lifts for Turnout Gates—The designs for handwheel gate lifts include four different types: (1) Handwheel gate lift with cast-in lifting nut; (2) with line-bearing lifting nut; (3) with ball-bearing lifting nut, and (4) geared gate lift with ball-bearing lifting nut.

The principal difference in the various types of gate lift lies in the design of lifting nut. In the type with the cast-in lifting nut a bronze bushing is cast into the hub of the handwheel. This is usually accomplished by pouring the cast iron around the bronze bushing. In the line-bearing type the bronze lifting nut is a separate part. The thrust collar on this nut is designed to provide a line contact with the bearing surfaces, resulting in comparatively low friction. In the ball-bearing type the friction is still further reduced by ball bearings, which are provided on both sides of the thrust collar. Ball bearings are also used in the geared-lift type and in addition this lift is provided with a set of spur gears to increase the capacity. The capacities of the various types of gate lifts vary in fairly uniform increments from 425 lb. for the simplest 12-in. handwheel lift to 2,420 lb. for the single-threaded geared gate lift. By reference to the table the reader will find the stem specifications and capacities of different gate lifts for which designs have been prepared.

Cast-Iron Gates for Canal and Reservoir Outlets—The designs for cast-iron gates include three different

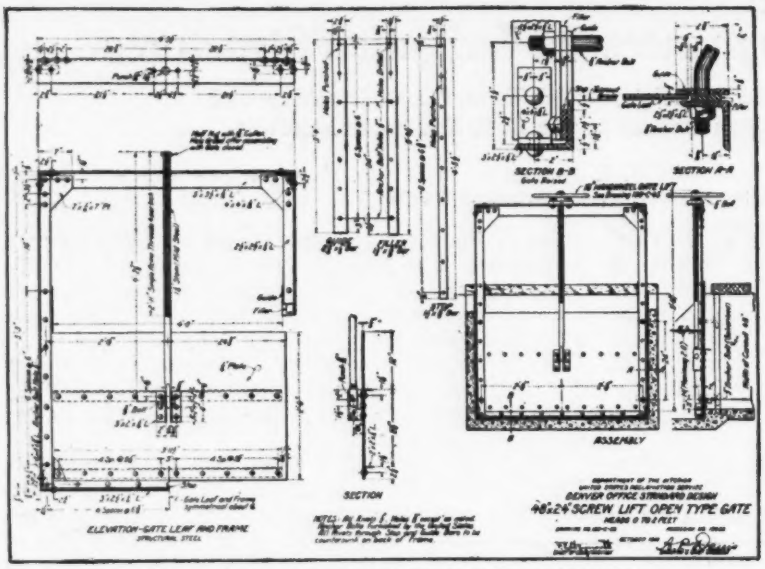


FIG. 2. SCREW LIFT OPEN TYPE GATE, 48 X 24 IN.

types: (1) For heads 0 to 15 ft.; (2) for heads 15 to 30 ft., and (3) for heads 30 to 50 ft.

Designs have been completed for 33 different size gates of these general types. The gates for heads 0 to 15 ft. are very similar to those for heads 15 to 30 ft., Fig. 3, the principal difference being the heavier castings in the latter. In both cases the sliding surfaces are cast iron on cast iron, the comparatively low heads not requiring bronze surfaces. The gates for heads 30 to 50 ft. are of quite different type as these higher heads require the introduction of air in considerable quantities and the use of bronze strips on at least one of the sliding surfaces. The bronze surfaces can for important installations be put on both the gate and frame. The introduction of air is necessary to prevent vacuum conditions below the gate when discharging in a partially open position. Any considerable vacuum results in the disintegration of metal and concrete surfaces by cavitation and serious damage will result if air is not admitted below gates which are subjected to high water velocities. The hollow frame of the gate was designed to admit air not only at the top of the gate opening but also along the sides, permitting a thorough distribution of air to all points where a vacuum tends to form. The bottom of the gate frame is flush with the conduit both above and below the gate and no air is required at this point.

Hoists for Cast-Iron Gates—The hoists for cast-iron gates are illustrated by three representative designs: (1) Handwheel gate hoist; (2) single-geared gate hoist, and (3) double-geared gate hoist. Designs have been completed for twelve different hoists of these general types, ranging in capacities from 690 lb. for the 24-in. handwheel gate hoist to a maximum of 15,225 lb. for the 24:1 geared gate hoist. Designs are under way for power-operated gate hoists of greater capacity and it is probable that these will be standardized for capacities up to about 40,000 lb. The capacities as discussed herein are based on a crank pull of 20 lb. and a sliding coefficient of 0.35 between gate and frame. All gate hoists and gate lifts are, however, designed safe for a crank pull of 40 lb. and a sliding factor of 0.70 (for starting gate) so that the actual safe capacity of all gate hoists and gate lifts is double the rated capacity.

The stems for all gate hoists are cold-rolled shafting cut with acme threads and all nuts are threaded $\frac{1}{8}$ in. over size to provide a loose fit between the stem and nut. This has been found essential to eliminate binding due to rusting or other coating on the stem. The designs, stem specifications and capacities of 61 different gate hoists have been prepared.

Radial Gates for Canal Headworks, Checks and Wasteways—The designs for radial gates include 49 different sizes, ranging from a width of 6 ft. and height of 3 ft. up to a width of 20 ft. and a height of 11 ft. The gates are all of the general type shown in Fig. 4 and consist of structural steel frames with corrugated galvanized steel face plates. Each gate is provided with an extension of variable height (up to about 1 ft.) so that the total gate heights can be varied to fit closely the water depth. The gate sills are made of wood which permits easy fitting to the concrete floor of the structure, resulting in a water-tight joint at the bottom of the gate. The side seals consist of sections of rubber hose fastened to the edge of gate in such manner as to seal completely the clearance spaces between the ends of the gate and the structure walls. The radial gate rotates on pins held in pin bearings embedded in the walls. For large gates the pin bearings are of cast iron with anchor bolts for distributing the gate load to the concrete structure walls.

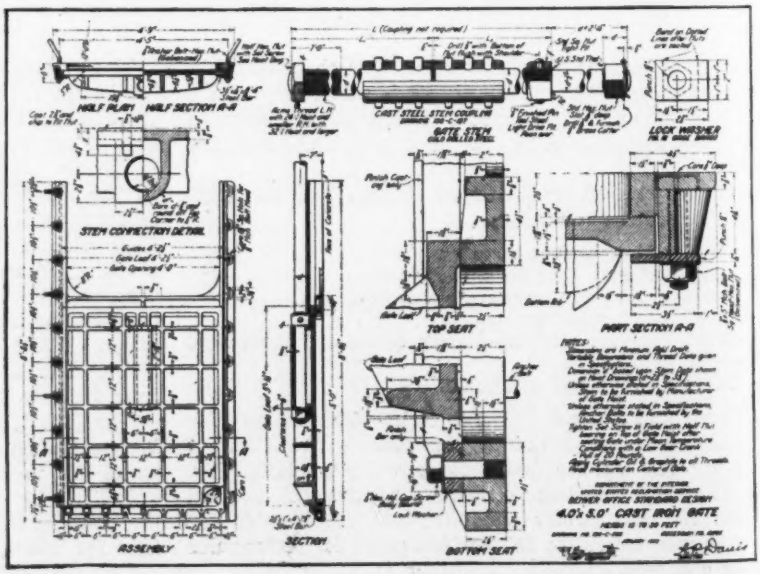


FIG. 3. CAST-IRON OUTLET GATE, 4 X 5 FT.

STEM SPECIFICATIONS AND CAPACITIES OF DIFFERENT GATE LIFTS

Handwheel Lifts Size, In.	Type	Stem Dia. In.	Acme Threads	Max. Unsupported Length At Threads Ft.	In.	In Body Ft.	In.	Capacity, Lb.
12	C*	1	Single 4 per inch	3	11	7	6	425
15	C	1¼	Single 4 per inch	5	0	9	3	495
18	C	1½	Single 4 per inch	6	3	10	5	550
21	L	1¾	Single 4 per inch	5	9	9	7	640
24	L	1¾	Single 4 per inch	7	6	11	10	695
27	L	1¾	Single 4 per inch	6	8	10	6	780
30	L	1¾	Single 4 per inch	6	2	9	11	865
18	B	1⅞	Single 4 per inch	6	7	10	3	965
18	B	1⅞	Double 4 per inch	7	5	11	6	785
24	B	1⅞	Single 4 per inch	5	7	8	8	1,285
24	B	1⅞	Double 4 per inch	6	5	9	9	1,045
30	B	1⅞	Single 4 per inch	4	10	7	9	1,600
30	B	1⅞	Double 4 per inch	5	7	8	9	1,305
15	4:1 Geared	1¾	Single 3½ per inch	6	3	9	9	2,420
15	4:1 Geared	1¾	Double L=0.5714 in.; P=0.2857 in.	7	2	11	0	1,980
15	4:1 Geared	2	Single 3 per inch	9	2	14	0	2,120
15	4:1 Geared	2	Double L=0.6666 in.; P=0.3333 in.	10	4	15	9	1,730

*"C" refers to cast-in lifting nut; "L" to line bearing nut and "B" to ball bearing nut.

Radial Gate Hoists—The designs for radial gate hoists include five different capacities, ranging from 1,200 to 7,500 lb. All of the hoists are of the same general types, consisting of two drums on a line shaft which is operated by a worm gear. The smallest capacity hoist has the worm gear only, while single- and double-spur gearing is used to increase the power in the larger capacity hoists. All gears are of cast iron, pinions of cast steel and worms of soft steel. The base, bearings and drums are of cast iron. Shafts are of cold rolled steel.

Gate Stem Couplings and Guides—Standard designs have been prepared for gate stem couplings and for stem guides. The stem couplings consist of cast steel, cold rolled steel or forged steel sleeves having a light drive fit with the ends of stem. The sleeve is fastened to the stem by means of finished taper pins of medium steel. The taper pins are held in place by brass cotter pins. Couplings are provided for stems varying in size from 2 to 5 in. in. diameter. A similar design has been prepared for reduction couplings by which two stems of different diameters can be coupled together. The reduction coupling is not often required but is sometimes used where the threaded portion of the stem is made larger than the rest of the stem.

The stem guides consist of two iron castings, one bolted to the concrete face wall of the structure and supporting the other casting which forms the guide for the stem. Both castings are made adjustable by slotted holes in order to facilitate the alignment of stem. The design for stem guides covers stems from 1 to 3½ in. in diameter. A similar design covers larger stems up to 6 in. in diameter.

Advantages of Standardization—The standardization of mechanical appliances has resulted in many advantages, among which are the following:

(1) The cost for engineering is very materially reduced as the standard designs when once prepared are made available for all projects in the service. Duplication of designing work is eliminated and the engineering work on the projects is reduced due to the similarity of devices and the repetition of work in their installation.

(2) The purchase of the mechanical appliances is expedited as this does not have to await the preparation of special designs.

(3) The construction of concrete structures is expedited as this does not have to await the preparation of designs or delivery of mechanical appliances. The anchor bolt layout and other details are known and the appliances can be bolted to the structures after the completion of the concrete work. They do not need to be on hand at the time the structure is built.

(4) The standard designs have been prepared in sufficient detail to serve as shop drawings, a complete detail drawing having been made for each size of appliance. As a result most manufacturers do not incur the expense of making shop drawings in filing orders for standard appliances. This saving in engineering expense on the part of the manufacturer is of course reflected in the bid prices on the standard appliances.

(5) Manufacturers who make a specialty of irrigation appliances are gradually accumulating patterns for castings used in the standard designs and even where the patterns are not in stock manufacturers are known to omit pattern costs when bidding on the standard appliances in the expectation of using the patterns for future orders. In this way the standard designs have greatly reduced the costs for standardized appliances.

While the value of the standardization work has been fully demonstrated by the completed designs of mechanical appliances, it is expected that very much greater value will result from the standardization of structures. The structure designs will include such structures as turnouts, drops, checks, chutes, weirs and many combinations of these structures. Extensive use will be made of precast concrete construction and a large number of designs are already completed (not yet lithographed) for structures of precast concrete.

The large demand for the standard designs of the Reclamation Service indicates that extensive use of the designs is being made by different foreign interests, and also by various private irrigation districts in the United States. Many of the manufacturing companies who specialize in irrigation appliances have adopted as

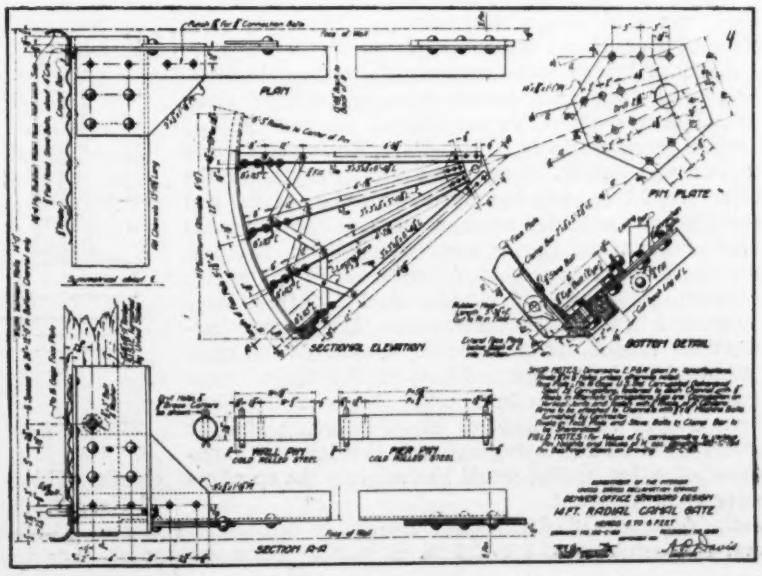


FIG. 4. RADIAL CANAL GATE, 14 FT.

standard, the designs of the Reclamation Service, and in this way the advantages of this standardization work are designed to reach many of the smaller private projects which might otherwise fail to discover the availability of the designs. Lists of the available designs which have been lithographed can be secured upon application to the chief engineer of the Reclamation Service, Denver, Colo.

The standardization work is being done by the designing department in the Denver office of the Reclamation Service, under the general direction of A. P. Davis, director, and F. E. Weymouth, chief engineer.

Concrete Continuous-Truss Bridge Without Diagonals

French Structure 135½ Ft. Long Has Steel X-Frames in Posts and Gussets Instead of Usual Diagonal Members

A TWO-SPAN continuous-truss reinforced-concrete deck bridge in which no diagonal members are employed, but having the vertical reinforcement so arranged as to take care of the diagonal stresses, is a curious structure built recently by the Paris, Lyons

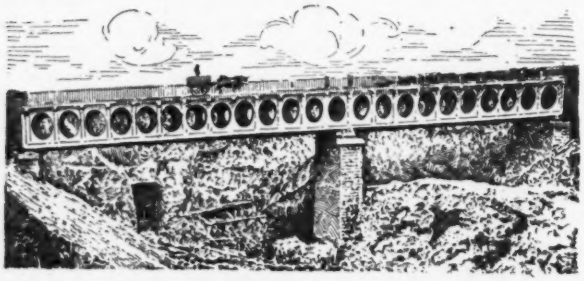


FIG. 1—FRENCH CONTINUOUS-TRUSS CONCRETE BRIDGE

& Mediterranean Ry. at Randan, France, to carry a highway across a deep cut on the new line from Riom to Vichy. This bridge, shown in Fig. 1, is described in the September number of the *Revue Generale des Chemins de Fer* by E. Chartiee and G. Blot, two engineers of the railway. The contractors were Lossier, Mallet & Co.

An arch bridge was impracticable because in addition to the two main tracks there was a third track at a higher elevation on one side of the cut. It was decided therefore to build a center pier for two spans of 75.6 and 58.3 ft. Since the available depth for the structure, 9.7 ft., was too much for a plate girder and too little for a lattice truss, a truss design composed only of horizontal chords and vertical posts was proposed. To provide against deformation at the angles between the posts and chords, steel X-frames were introduced in the post reinforcement, these frames having their extremities embedded in the chords and their intersections in the neutral axis of the truss. This arrangement is shown in Fig. 2. If the concrete had been shaped to the lines of the reinforcing steel it would have formed octagonal web openings with unequal sides, but as this would be unsightly the openings were made elliptical.

Each truss is 135.6 ft. long, with chords 22 in. deep and varying from 22.4 to 26 in. in width. Posts are

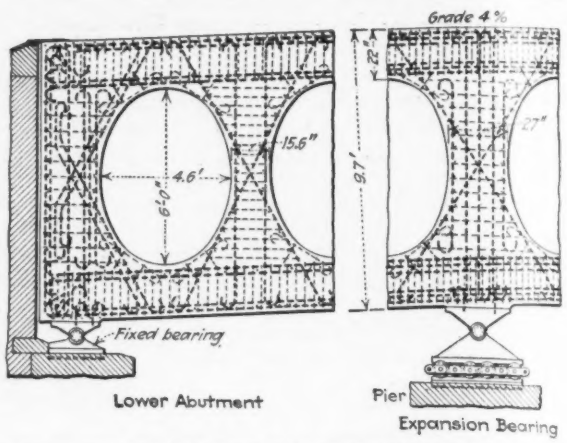


FIG. 2—CONCRETE TRUSS HAS CHORDS AND POSTS ONLY

spaced 5.77 ft. c. to c., except that over the pier and abutments the spacing is 6 ft. The bridge is on a grade of 4 per cent and has expansion bearings on the pier and upper abutment, with fixed bearings on the lower abutment. No sway bracing is used, but the floorbeams between the top chords are shaped with knee braces against the posts. The beams over the bearings are of exceptional depth. The ordinary floor beams are 9 in. thick and 29½ in. deep including the 6½-in. deck slab. On the bottom of the slab is a central longitudinal rib. The trusses, floorbeams and slab constitute a monolithic structure. On the slab is a waterproofing course protected by a paving of lean concrete.

A pleasing appearance was desirable, as the bridge is near a station, and means were taken to offset the unsightly effects of form marks and discoloration so often seen in concrete structures. For this purpose shadow and relief effects are produced by corbels for the hand-rail posts, moldings on the outer faces of the top chords and ribs on the lower edges of the bottom

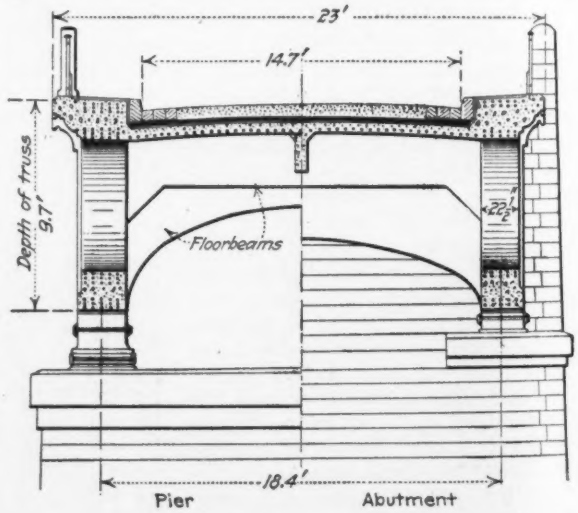


FIG. 3—CROSS-SECTION OF CONCRETE TRUSS BRIDGE

chords. This will be seen by Fig. 3. The exposed sides of the trusses are faced with 2 to 3 in. of cement mortar and finished with two coats of stone-colored paint.

Theory of Bond Issues for Road Construction

A Rational Method of Fixing the Ultimate Amount and Life Based on Possible Annual Expenditure for Maintenance

By Jeremiah C. Finch
Secretary, New York State Commission of Highways, Albany, N. Y.

THERE has been a great deal of discussion as to the proper method of financing such extensive highway improvements as are being undertaken by the various municipalities or subdivisions of the country. The original theory generally advocated was one of issuing long-term bonds on the assumption that the life of an improved highway was at least fifty years. In recent years there has been a tendency to decrease the term of the bonds or to substitute serial bonds, and, still more recently, many advocates have appeared for the "pay-as-you-go" policy. It has become a generally accepted theory that a highway shall not be built which will not last longer than the life of the bond, but the discussion has revolved around the question, what portion of a highway improvement is permanent, and the length of life of the portion not permanent.

In view of the fact that a very large proportion of the political subdivisions of the country are going into the question of highway improvement on as extensive a scale as they are able to finance, the proper theory on which to base their highway program is determined by the answer to the question: What amount of money can any municipality afford to raise for the permanent maintenance of a highway system? The funds available from direct taxes or other sources will limit the annual expenditure of any municipality for highway maintenance and reconstruction and the voters must be willing not only to obligate themselves to raise that sum annually but also to obligate posterity to continue to raise that sum annually for all time. Only under these conditions is a municipality justified in instituing a highway construction program of a magnitude which the annual highway fund will permanently maintain and reconstruct, but of no greater magnitude. It is therefore clear that no municipality has a right to issue bonds for the construction of a greater mileage of highways than posterity will be able to maintain without an undue burden, as it certainly would be most unjust to place a greater burden on posterity than the present generation is willing to assume.

Illustration of Theory—In order to illustrate this theory clearly a hypothetical case has been taken of a municipality which can afford a permanent highway maintenance and reconstruction budget of $2,000,000 and, for this purpose, it is assumed that a highway system costing $30,000,000 will eventually require at the expiration of 35 years a sum of $2,000,000 per annum to reconstruct and maintain the system in a condition to carry satisfactorily the traffic of the municipality. The amounts indicated each year in the accompanying table as necessary for maintenance are wholly empirical and no assertion is made that these are the exact amounts required in any given year for maintenance of any given highway system, as the amounts necessary from year to year will depend largely on the character and type of pavement laid, together with the nature of the traffic and soil conditions, and there are many other features which may enter.

It may be assumed, however, that maintenance and repair charges at the fourteenth year, when the average age of the pavements is eleven years, will be $400 per mile per year. Beginning with the fifteenth year, $50,000 will be available for reconstruction, and increasing amounts each year thereafter, so that sufficient moneys will have been available to reconstruct two-thirds of the system at two-thirds of its original cost in the thirty-four year period, the average age of the pavements in the thirty-four years being thirty-one years. Sufficient funds will be available so that all of the remaining one-third will have been constructed in the following four years. After that time, it is hardly

PLAN OF DISPOSAL OF BOND ISSUE FOR HIGHWAY IMPROVEMENT

Years	A Total Bonds Issued	B Accrued Retirement Fund	C Annual Amount Retired	D Term of Bonds	E Balance Bonds Outstanding	F Interest at 4 Per Cent	G Maintenance and Reconstruction	H Annual Highway Taxation
1	$6,000,000	.....	$1,760,000	Years	$6,000,000	$240,000	.....	$2,000,000
2	6,000,000	$1,760,000	1,590,600	1	10,240,000	409,600	.....	2,000,000
3	6,000,000	3,350,600	1,383,024	2	14,649,400	585,976	$25,000	2,000,000
4	6,000,000	4,733,624	1,179,345	3	19,266,376	770,655	50,000	2,000,000
5	6,000,000	5,912,969	961,519	4	24,087,031	963,481	75,000	2,000,000
6	.....	6,874,488	974,980	4	23,125,512	925,020	100,000	2,000,000
7	.....	7,849,468	988,979	5	22,150,532	886,021	125,000	2,000,000
8	.....	8,838,447	1,003,538	6	21,161,553	846,462	150,000	2,000,000
9	.....	9,841,985	1,018,680	7	20,158,015	806,320	175,000	2,000,000
10	.....	10,860,665	1,034,427	8	19,139,335	765,573	200,000	2,000,000
11	.....	11,895,092	1,025,804	9	18,104,908	724,196	250,000	2,000,000
12	.....	12,920,896	1,016,836	9	17,079,104	683,164	300,000	2,000,000
13	.....	13,937,732	1,007,510	10	16,062,268	642,490	350,000	2,000,000
14	.....	14,945,242	997,810	11	15,054,752	602,190	400,000	2,000,000
15	.....	15,943,052	987,723	12	14,056,948	562,277	450,000	2,000,000
16	.....	16,930,775	977,231	13	13,069,225	522,769	500,000	2,000,000
17	.....	17,908,006	966,321	14	12,091,994	483,679	550,000	2,000,000
18	.....	18,874,327	954,972	14	11,125,693	445,027	600,000	2,000,000
19	.....	19,829,299	943,172	15	10,170,701	406,828	650,000	2,000,000
20	.....	20,772,471	930,899	16	9,227,529	369,101	700,000	2,000,000
21	.....	21,703,370	918,195	17	8,296,630	331,865	750,000	2,000,000
22	.....	22,621,565	904,863	18	7,378,435	295,137	800,000	2,000,000
23	.....	23,526,428	891,058	19	6,473,572	258,942	850,000	2,000,000
24	.....	24,417,486	876,700	19	5,582,514	223,300	900,000	2,000,000
25	.....	25,294,186	811,768	20	4,705,814	188,232	1,000,000	2,000,000
26	.....	26,105,954	744,239	21	3,894,046	155,761	1,100,000	2,000,000
27	.....	26,850,193	674,008	22	3,149,807	125,992	1,200,000	2,000,000
28	.....	27,524,201	600,969	23	2,475,799	99,031	1,300,000	2,000,000
29	.....	28,125,170	525,007	24	1,874,830	74,993	1,400,000	2,000,000
30	.....	28,650,177	446,008	25	1,349,823	53,992	1,500,000	2,000,000
31	.....	29,096,185	363,848	26	903,815	36,152	1,600,000	2,000,000
32	.....	29,460,033	278,402	27	539,967	21,598	1,700,000	2,000,000
33	.....	29,738,435	189,538	28	261,565	10,462	1,800,000	2,000,000
34	.....	29,927,973	72,027	29	72,027	2,881	1,925,092	2,000,000
35	.....	30,000,000	None	..	None	None	2,000,000	2,000,000
	$30,000,000	.....	$30,000,000	12 Avg.	.....	$14,519,167	$25,475,092	$70,000,000

Column "C" plus "F" plus "G" equals column "H". Columns "B" and "E" equal total bonds which had been issued on any given year.

safe, due to the probable increasing traffic, to estimate that reconstruction costs will be less than the original construction cost, but, with $1,500,000 annually available for reconstruction after the thirty-eighth year, the entire system can be reconstructed every twenty years at its original cost and still set aside $500 per mile for maintenance and repair after the thirty-eighth year.

Maintenance vs. Reconstruction—If it be argued that the maintenance costs are estimated too high, the money saved can well be spent on reconstruction of the system at an earlier date than these computations will permit; and if it be argued that maintenance costs are estimated too low, either an extra appropriation for maintenance will be required for a few years or the retirement of the last of the bonds deferred.

There can be little argument as to the general proposition that after the lapse of thirty-five years from the beginning of construction or thirty years after the average date of completion that the average annual expenditure for maintenance and reconstruction will not be equal to 6⅔ per cent of the original investment. In any event a proper amount for maintenance and reconstruction covering every year of a thirty-four year period can be estimated from any given proposed construction program and used as a basis for a similar computation without altering the principles herein expressed.

A second assumption has been introduced that in a construction program of $30,000,000 it would be inadvisable to attempt to construct the same in a shorter period than five years so that the bonds would be issued at the rate of $6,000,000 per year. This, of course, could be modified to meet any given situation without altering the principles involved. Under this plan $2,000,000 would be raised annually by taxation. Figuring interest at 4 per cent, $240,000 would be required the first year for interest; the balance, $1,760,000, would be deducted from the first bond issue. The third year, assuming $25,000 for maintenance, the interest would amount to $585,976, leaving a balance of $1,383,024 to retire an equal amount of two year serial bonds. Similar computation for each successive year would retire the last installment of the bond twenty-nine years after they were issued and thirty-four years after the bond issue was authorized, leaving $2,000,000 available for maintenance and reconstruction during the thirty-fifth year and all succeeding years.

It is interesting to note that half of these bonds will be retired at the end of fourteen years, none of which will have been in existence over eleven years, and that two thirds of these bonds will have been retired at the end of nineteen years, none of which will have been running more than fifteen years.

If contributions by the federal government are injected into the computation it will not affect the ultimate amounts of money needed for maintenance at the end of thirty-five years, nor will it materially affect the amount of mileage which can be maintained unless the federal government will assume permanently a portion of the reconstruction charges. I am firmly convinced, however, that no state, county, town, city or village should blindly plunge into a road construction program which will eventually give them a mileage of highways greater than posterity can afford to maintain in as good condition as it was handed to them, and the only logical way to prevent such an outcome is to limit the construction program to the mileage of highways the municipality can afford to maintain permanently.

Reversible Manhole Covers to Replace Solid Type

Chicago Sewer Department Develops a Three-Piece Cover Lighter and Stronger than Standard—Tests Made

ENORMOUSLY increased cost of castings for manhole covers during the war started the Chicago Sewer Department on a hunt for a lighter design than the standard used for 25 years. Finally there was designed a cover in three pieces—base, ring or curb and lid—in which the curb can be reversed without tearing up the

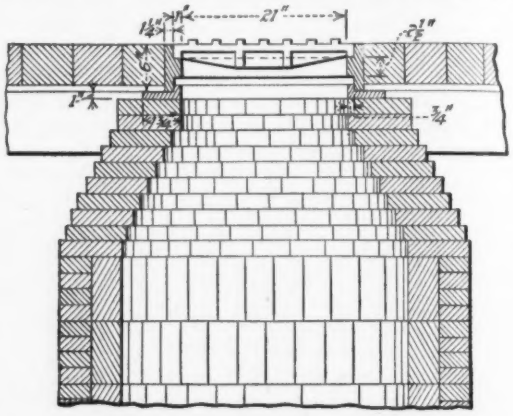


FIG. 1. REVERSIBLE MANHOLE COVER IN PLACE

adjacent pavement after the ledge supporting the lid has worn appreciably.

The new cover is about 90 lb. lighter than the standard design. The cost of restoring pavement due to replacing wornout two-piece covers is high since for a minimum pavement repair the charge is $20. In the downtown district this repair work required one bricklayer, three men and a team at least half a day. Installation of covers or replacements of the old type, including charge for restoring pavements, costs an average of $56.50. The first replacement of the reversible type, which means simply prying out the curb and turning it over without disturbing the pavement, costs $5.50. After both shoulders of the ring or curb have been worn down the ring can be replaced at a cost of about $6, plus $5.50 for labor. With

FIG. 2. REPLACING STANDARD TYPE OF MANHOLE COVER
Takes one-half day, interrupting traffic and costing $56.50.

the new cover the base is set on the masonry and remains permanently in place. Resting on the base is the curb which has two flanges or ledges exactly alike, either one of which may be used to support the lid. This feature doubles the life of the cover and saves the adjacent pavement. The first of the new covers was placed two years ago in front of Marshall Field's on State St. and about 200 have been set in the most congested portions of the business district.

FIG. 3. REVERSING RING
Ring pried out of pavement and turned over at cost of $5.50.

For experimental purposes some of the newly installed curbs have been reversed without any effect on the pavement. The operation of prying the ring up out of a wood block pavement and hammering down the adjacent pavement with a maul was carried out for a representative of *Engineering News-Record* to photograph on Monroe St. between State St. and Wabash Ave. without interrupting the continuous line of traffic on either side. A serious pavement difficulty attends this kind of replacement in that traffic cannot be kept from the new patch. In consequence, settlement of the concrete base is almost sure to result. Due to the large increase in motor vehicle traffic the old covers, of which the sewer and water departments have about 300,000, are wearing out rapidly. Few covers in the downtown district last more than fifteen years and it is now the practice to install new ones when pavements are relaid. The life of pavements in the downtown district averages seven years. One of the photographs shows the worn and broken ledge of a cover on Monroe St. near the other two shown. This cover was considered extra hazardous to traffic and ready for replacement after eight years.

RESULTS OF DROPPING 1,200-LB. WEIGHT ON STANDARD AND REVERSIBLE MANHOLE COVERS

	Weight Lb.	Resistance in Ft.-Lb.	Ft.-Lb. per 100-Lb. Metal	Remarks
Heavy Type, Curb and Bases 21 in. in Diameter				
Reversible	315	20,400	6,476	Not broken
Reversible	316	19,200	6,076	Cracked (base only)
Reversible	313	20,400	6,517	Not broken
Standard	416	13,200	3,173	Broken
Standard	418	14,400	3,445	Broken
Standard	417	14,400	3,453	Broken
Medium Type, Curbs and Bases 21 in. in Diameter				
Reversible	281	20,400	7,224	Not broken
Reversible	283	20,400	7,209	Not broken
Reversible	283	20,400	7,209	Not broken
Standard	415	14,400	3,470	Broken
Standard	413	12,000	2,905	Broken
Standard	416	13,200	3,173	Broken

FIG. 4. LEDGE OR CURB WORN TO DANGER POINT
This cover was replaced in January. Pavement dropped about 1-in. for an area of more than a yard around it.

Tests of the old and new manhole covers have been made at the plant of the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., by dropping on them a 1,200-lb. weight various distances. For testing the curbs a heavy cast-iron base was provided with the top grooved to receive the manhole curb casting. The curb fits the base close enough to prevent any lateral movement of the curb. A layer of riddled sand 1 in. deep was placed between the base plate and the casting under test to insure an even bearing. The anvil was a heavy casting with the base machined to fit the curb in place of a standard lid. After each drop the casting was inspected for any cracks or distortion of metal which were considered the point of failure. Castings of the different designs were poured from the same ladle to make the tests comparative. For curbs the drop started at 6 ft. and was increased by 1-ft. increments until the casting broke or the limit of the electric hoist, 17 ft., was reached. For lids the test started with a drop of 18 in., which was raised by 3-in. increments until the casting failed.

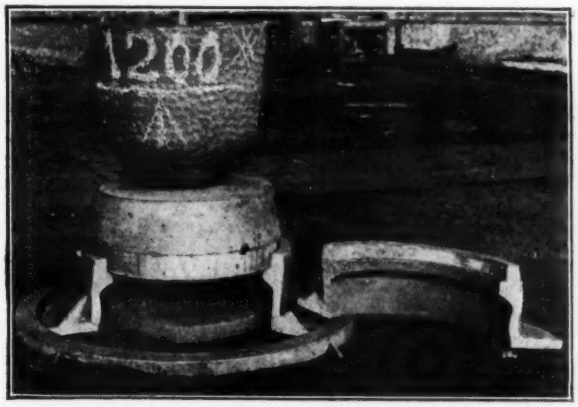


FIG. 5. TEST APPARATUS FOR BREAKING MANHOLE COVER BASE AND CURB

Heavy lids weighing 155 to 158 lb. broke at a load of 3,300 ft.-lb. and medium lids weighing 116 to 118 lb. broke at 3,000 ft.-lb. All lids broke at the same height of drop, but the lighter sections deflected under the blow and the weight rebounded after striking. Before breaking the medium lids dished $\frac{5}{16}$ to $\frac{1}{2}$ in. at the center.

Maintenance of Chicago sewers is handled by George E. McGrath, superintendent of the sewer department. The new cover design was worked out and patented by Frank Shanley, in charge of sewer construction, Bureau of Sewers.

Flood Protection Needed in Indianapolis

Flood dangers in Indianapolis were reported upon recently by a committee of the Indianapolis Chapter of the American Association of Engineers, with the result of showing that channel improvement work and enlargement or clearing of bridge waterways is urgently needed if the risk of inundation and serious property damage in extreme high-water periods are to be avoided. The work to be done lies chiefly between the mouth of Fall Creek near 10th St. on the north side and the Belt R.R. bridge near Raymond St. on the south side. Several bridges are of insufficient length, and one railroad trestle is almost certain to clog with debris in an extreme flood and go out; another bridge is too low. Protection can be secured by building flood walls instead of clearing the channel.

Arch Dam Temperature Changes and Deflection Measurements

A Suggested Method of Experimentation With Full Size Structures Which May Give Information Useful in Design

By Fred A. Noetzli
Chief Engineer, Bissell and Sinnicks, Consulting Engineers, San Francisco, Calif.

CONSIDERABLE tension stress and probably open cracks occur in some existing arch dams, both in vertical as well as in horizontal planes. Several kinds of forces and other influences, such as temperature, shrinkage, etc., may occur in such dams, besides water pressure. It is the object of this article to call the attention of engineers to the importance of such often-fluctuations of the temperature during the seasons and at various elevations between base and crest. Some measurements have been made on certain dams of the gravity type, notably the Arrowrock Dam (see *Transactions*, Am. Soc. C. E., Vol. LXXIX, 1915, p. 1225 and Vol. LXXXIV, 1921, p. 109), but it is doubtful if the conditions in the enormous masses of concrete of gravity dams are truly representative of what may occur in this respect in the arches of a slender arch dam. It is therefore most desirable that characteristic series of temperature measurements be also made on dams of this kind. However, such investigations may be delayed for a considerable period of time before new structures have been built and equipped with adequate measuring devices, not to speak of the time it will take from there on, to obtain the truly representative series of figures, which may require years of careful observations.

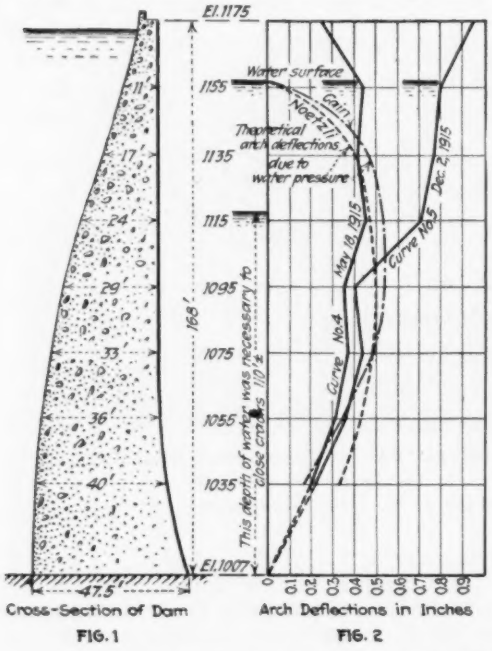


FIG. 1

Water surface
Gain
Noetzli
Theoretical arch deflections due to water pressure
This depth of water was necessary to close cracks
Curve No. 4 May 18, 1915
Curve No. 5 Dec. 2, 1915
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
Arch Deflections in Inches

FIG. 2

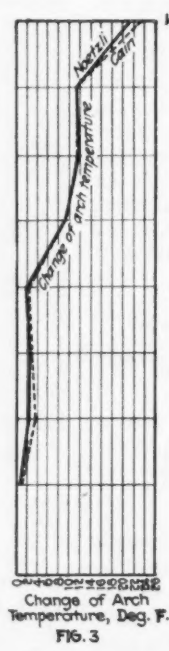


FIG. 3

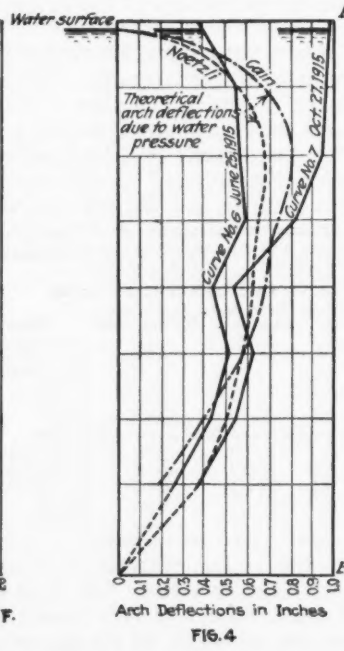

Water surface
Noetzli
Gain
Theoretical arch deflections due to water pressure
Curve No. 6 June 25, 1915
Curve No. 7 Oct. 27, 1915
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Arch Deflections in Inches

FIG. 4

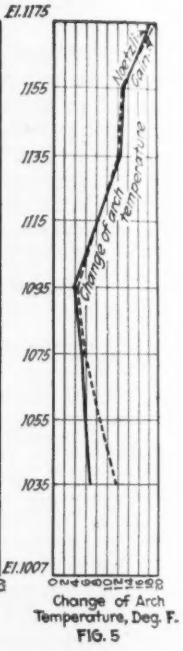


FIG. 5

FIGS. 1 TO 5—DEFLECTIONS AND TEMPERATURE CHANGES OBSERVED IN THE SALMON CREEK DAM

neglected influences, and to indicate ways and means of analyzing their effect. As temperature variations are probably of primary importance besides the water pressure itself, special attention will be given in this article to temperature phenomena, and a method will be shown by which the change of temperature in arch dams can be estimated from measured deflections.

It is a well-known fact that temperature variations in the concrete of arch dams are responsible for deflections which under certain conditions may be larger than the deflections due to the water pressure itself. An increase in the arch temperature will push the arch crown in an upstream direction while a decrease corresponds to a downstream deflection. It is evident that such movements, which may occur entirely independent from the water load, will result in additional bending moments and stresses being put up in the arches, and they are, therefore, of a certain importance for the design of structures of this kind.

So far as the writer knows there are no direct measurements of temperature variations in arch dams available which would furnish a reliable record of the

It is possible, however, to estimate the temperature changes in arch dams from deflection measurements, and it is the purpose of this article to demonstrate a method leading to fairly accurate results by very simple calculations.

The elastic theory of the arch permits to figure the deflections of an arch if the loads, changes of temperature, shrinkage, etc., are known. Consequently, if all the unknown quantities, except one, are kept constant, the measurement of the arch deflections which are then due entirely to the one variable quantity, may lead to estimating the size of this unknown quantity. For example, if for an arch dam the deflections have been measured during various seasons when the water in the reservoir stood at exactly the same elevation, it is then reasonable to assume that any difference in the deflection at the two moments of observation is due mainly to a variation of the arch temperature. Of course, the elementary arch slices of arch dams are not free to slide one over the other, as is generally assumed for theoretical investigations, and the arch deflections at the various elevations may therefore be influenced some-

what by this fact and also by vertical cantilever action. Nevertheless, such investigations may be of assistance in forming an idea as to the importance of temperature changes in arch dams.

In a paper, entitled "The Circular Arch under Normal Loads," by Professor William Cain (*Proceedings*, Am. Soc. C. E., October, 1921, p. 285), an exact formula is developed by which it is possible to calculate for a change of arch temperature the crown deflection of a hingeless elastic arch. Based upon this formula, the change of the arch temperature for a measured deflection may be calculated for an arch slice of 1 ft. thickness by the equation,

$$T = \frac{(\phi + \frac{1}{2}\sin 2\phi)\left(1 + \frac{k^2}{R^2}\right) - \frac{1-\cos 2\phi}{\phi}}{hc\sin\phi\left[(1+\cos\phi)\left(1+\frac{k^2}{R^2}\right) - 2\frac{\sin\phi}{\phi}\right]} \cdot D \quad (1)$$

in which

T = uniform change of arch temperature in degrees F.;
D = deflection of arch crown;
c = coefficient of expansion;
R = radius of center line of arch;
h = rise of center line of arch;
k = radius of gyration of arch section $= \frac{1}{12}t$;
t = thickness of arch;
ϕ = half central angle of arch.

All dimensions are measured in feet.

In a paper entitled "Gravity and Arch Action in Curved Dams" (*Transactions*, Am. Soc. C. E., Vol. LXXXIV, 1921, p. 12), the writer has developed an approximate formula for arch deflections resulting from temperature changes,

$$D = 1.56\,RcT$$

from which

$$T = \frac{1}{1.56\,Rc}D \quad (2)$$

The notation is the same as given above.

By measuring the deflection, D, in inches, as is usually done, and by assuming for average cases the coefficient of expansion $c = 0.000\,0055$, there results the simple formula,

$$T = 10{,}000\,D/R \text{ (approximately)} \quad (3)$$

Equation (3) is about as simple as possibly may be expected for a problem which theoretically is as complicated as is well illustrated by Equation (1). Nevertheless, the approximate formula (3) furnishes fairly reliable results for the upper parts of most arch dams, and for which the proportion between thickness and rise of arch is less than about 0.8. For thick and flat arches this formula cannot be expected to furnish other but rough approximations, and in extreme cases the value of T by (3) is only about 50 per cent of T calculated by Equation (1).

It is of importance to note that in the above formulas for temperature variations the modulus of elasticity of the arch material does not occur, and, consequently, a factor of considerable uncertainty is thus eliminated. It would appear, therefore, that the only assumptions to be made are with regard to the "fixity" of the arches and the coefficient of expansion, c. For a dam under pressure the arches may be assumed as rigidly fixed at the abutments unless calculations or observations should indicate the occurrence of open cracks. The coefficient of expansion, c, may probably be judged within 10 per cent to 20 per cent and therefore the accuracy of equation (1) would appear to be also within such limits for the freely arching parts of arched dams and for uniform temperature changes.

Example—A very interesting set of deflection measurements was made on the Salmon Creek Dam in Alaska. The deflection curves of this structure were published and discussed by L. Jorgensen (*Transactions*, Am. Soc. C. E., Vol. LXXXIII, 1919-20, p. 316), who is the designer of the dam. Some of the curves which are of particular interest with regard to the subject of the present article are shown on Figs. 1 to 5.

It is of interest to note that Curve No. 4 of May 18, 1915, and Curve No. 5, of Dec. 2, 1915 (Fig. 2) represent deflections of this dam with the water level in the reservoir being very nearly at the same elevation on both dates. This is also the case for Curve No. 6 of June 25, 1915, and Curve No. 7, of Dec. 27, 1915 (Fig. 4), respectively. From a comparison between each set of curves in Figs. 2 and 4, it is evident that other influences besides water pressure must have been at work to cause such large variations in the arch deflections for the same water load.

It is most probable that the chemical heat of this comparatively slender arch dam had been lost during the severe winter which intervened between the completion of the dam in the summer of 1914 and the date of the measurements relating to these deflection curves. Apparently the dam had also taken its "initial set" prior to these measurements, as indicated by the note that the pressure of about 110 ft. of water in the reservoir was necessary to keep the construction joints closed. The influence of lateral expansion (Poisson's ratio) and of swelling, etc., was probably the same for each of the two sets of deflections, so that with reasonable certainty it may be assumed that the difference in deflection at the various elevations was due entirely to the difference of the arch temperature on the two respective days that the measurements were taken.

TABLE SHOWS TEMPERATURE EFFECTS ON SALMON CREEK DAM

Elevation	Radius of Arch Axis	Thickness of Arch	Central Angle	Curves 4 and 5			Curves 6 and 7		
				Temperature Deflection	Difference of Arch Temp. Degrees Fahr.		Temperature Deflection	Difference of Arch Temp. Degrees Fahr.	
	R	t	2φ	D (inch)	Cain	Noetzli	D (inch)	Cain	Noetzli
1	2	3	4	5	6	7	8	9	10
Crest 1175	328 ft.	6 ft.	114°	0.70	22.6	21.3	0.62	20.0	18.9
1155	322	11	100°	0.37	11.5	11.5	0.42	13.0	13.1
1135	303	17	92°	0.30	11.7	11.9	0.38	12.4	12.5
1115	282	24	88°	0.26	9.3	9.3	0.23	8.2	8.2
1095	260	29	85°	0.05	2.1	1.9	0.10	4.3	3.9
1075	236	33	86°	0.06	2.8	2.5	0.12	5.7	5.1
1055	208	36	76°	0.05	3.5	2.4	0.12	8.4	5.8
1035	174	40	69°	0.01	1.0	0.6	0.11	11.4	6.3
Base 1007									

Furthermore, it is probable that for this particular dam the arch action is much less restrained by vertical cantilever action, than might be assumed otherwise, because calculations made by the writer (published in the papers referred to previously) seem to indicate that the vertical cantilever of this dam is broken at various elevations. These considerations may justify the use of Equations (1) and (3) for determining the variations of the arch temperature which apparently was responsible for the difference in the arch deflections, and they may give confidence in the reliability of the results without a special investigation for combined cantilever and arch action being necessary.

The accompanying table gives the arch elements for various elevations, and also the difference of the arch temperatures as determined by Equations (1) and (3).

(Slide rule accuracy.) The values for T were plotted on Figs. 3 and 5. The remarkably close coincidence between the results obtained by the theoretically exact Eq. (1) and by the approximate Formula (3) is well illustrated by the lines of Figs. 3 and 5. A considerable discrepancy exists only for the lower thick and flat arches of this dam for which the approximate formula probably should not be used if a maximum degree of accuracy is desired.

In the above investigations it was assumed that the variation of the arch temperature occurred uniformly over the whole cross-section and along the entire length of each elementary arch slice. It is obvious, however, that a marked difference may exist at certain times between the temperature of the arches on the water and on the air side respectively. Such differences, of course, could be determined only by careful measurements of the temperature of the dam body itself.

The deflection and temperature curves in Figs. 2, 3, 4 and 5 show clearly the influence of the air temperature near the crest of this dam. At El. 1095 a "knee" occurs both in the deflection as well as in the temperature curves. The construction of the dam had been interrupted during the winter when the dam had reached El. 1095, and concreting was continued only in the following spring. Thus, the arch ring below El. 1095 which had been constructed during the cold season did shrink less than the other arches above or below. Consequently, it took a greater portion of the load when the arch came under pressure and some load was transferred by shear and vertical beam action to this portion both from above and below. This load distribution may have been changed somewhat by a variation of the temperature conditions, and this probably accounts for the irregularity of the temperature curves. At the same time this phenomenon illustrates the necessity of co-ordinating design and construction of such a dam.

From the table and the curves of Figs. 3 and 5, it is seen that the average temperature of the body of the Salmon Creek Dam varied for about 15 deg. to 25 deg. near the crest and for approximately half this amount near the base. Of course, it cannot be assumed that the deflections were measured at the seasonal maximum and minimum which for this dam occur probably in August and February, respectively. Those figures nevertheless indicate the large variations of temperature which may occur in slender arch dams.

For the sake of comparison between theoretical and actual deflections, the arch deflection curves resulting from water pressure alone, are shown in Figs. 2 and 4. These deflections were calculated by Professor Cain's exact and the writer's approximate deflection formulas for water pressure. These formulas may be found in the papers referred to previously.

Conclusions—The investigations published in this article with regard to temperature changes in arch dams were made less for the purpose of illustrating the conditions of the Salmon Creek Dam, than with the aim of inducing engineers to measure the deflections of existing arch dams more frequently and more systematically than has been done in the past. The formulas given (and others published in the papers referred to elsewhere) may further be used as simple but very powerful instruments for determining by observations the effect of certain still somewhat obscure actions, such as shrinkage, swelling, flow of concrete, ice pressure, etc., in dams under various load and temperature conditions.

The deflection of an arch dam may in the main part be due to the following reasons: Water pressure; cantilever action; change of temperature; shrinkage of concrete; swelling; "flow" of concrete; lateral expansion (Poisson's ratio); ice pressure; etc. In many cases it may be possible to predetermine, measure or keep constant all the unknown quantities except one, and then measure the deflections and calculate the size of the unknown factor.

Such an example has been given for the Salmon Creek Dam with regard to temperature, and for future investigations, such calculations might be supplemented by measuring the air and water temperatures at various depths and comparing with the calculated arch temperatures. Ice pressure could be determined similarly if the water pressure is kept constant and the arch temperature is either measured or estimated, for instance by comparing with observations made previously.

Shrinkage of the concrete may be determined either by measuring and adding all the visible cracks, or by observing the deflections when the dam comes under pressure for the first time and at the instant when all the visible shrinkage cracks are being closed.

Flow of concrete might be detected by measuring the increase of the arch deflections, when load and arch temperature are being kept constant, etc. Ultimately, it may even be possible to get also some information with regard to the modulus of elasticity of large dams.

It is not claimed that all of the above-mentioned unknown quantities are capable of determination within close limits of accuracy. Some of them, such as temperature and coefficient of expansion, cantilever action, shrinkage, flow of concrete and ice pressure will probably in time be brought fairly well under control. Some others may defy all attempts or possibly be found of such small influence that they may be either combined, or neglected all together. In any case, it will require long series of very accurate observations covering a wide range of conditions in order to crystallize out some final and reliable results.

Thus, there offers itself to hydraulic engineers a most interesting and fascinating field of activity, and it is to be hoped that members of the profession who have the opportunity to make deflection measurements of arch dams will avail themselves extensively of the opportunity to enlighten our present limited knowledge on this subject and thus to help for future progress to be made in arch dam design.

Suit for Damage to Bridge Pier by Blasting

The Supreme Court has decided that the Keokuk & Hamilton Bridge Co. is entitled to only nominal damages for injury to a protection pier of its bridge over the Mississippi River due to blasting by the government in channel work. The lower courts were sustained by the decision. It was held by the lower courts that the damage to the pier could have been repaired for $1,000. Instead of repairing the pier, however, the bridge company decided to rebuild the bridge to stand heavier traffic and brought suit against the government, alleging that the pier had been destroyed and in that way had been taken by the United States. This contention was not upheld by any of the courts.

Urges Co-operation Between Railroads and Motor Trucks

Railroad Executive Seeks Solution of Terminal and Branch-Line Problems in Joint Motor-Truck Delivery and Short-Haul Service

By W. H. Lyford
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In an address delivered before the second national conference on education for highway engineering and highway transport, held in Washington, D. C., on Oct. 28, 1922, W. H. Lyford, vice-president of the Chicago & Eastern Illinois Railway Co., analyzed the present freight transportation problem of the country and outlined some of the methods by which he believes they will be solved. Mr. Lyford stressed the inadequacy of terminal facilities and the resulting inefficient use of railroad equipment, and developed his ideas with regard to more effective collection and delivery and a more economical allocation of freight traffic to railroad and highway carriers. The following is an abstract of Mr. Lyford's address.—Editor.

IN THIS discussion the term "complete transportation" will be used to describe the handling of goods all the way from the premises of the shipper to those of the consignee. The term "trader" will apply both to shipper and to consignee. The trader is concerned only with complete and trustworthy transportation available at a cost that will be low enough to avert the danger of curtailing his trade. Charges, therefore, must be as low as is consistent with the maintenance of adequate, regular and prompt service.

Complete transportation cannot be furnished regularly and promptly, however, unless the charges of the carriers are high enough to pay all the expenses of carriage plus a profit sufficient to warrant the investment of capital and energy to install the service and to keep it abreast of increasing traffic demands. In normal times, the volume of freight traffic in this country increases at a rate of not less than 6 per cent per year.

Classes of Transportation—Transportation of goods falls into four general classes: Parcel post, express, less-than-carload or package freight (commonly called l.c.l.), and carload freight. The essential difference between carload and l.c.l. freight is that the former is loaded and unloaded on an industry track or a team track at the expense of the trader, while l.c.l. freight is loaded and unloaded and passed through a station at the expense of the railway. Carload rates, therefore, are substantially less per ton than l.c.l. rates for carrying the same goods.

Collection and Delivery—In all these classes the railway actually performs the entire transportation service except the movement between the premises of the traders and the stations of the railway company. As the collection and delivery of freight must be performed at the expense of the trader, industries have been located as closely as possible to railway stations, which practice results in congested districts at such points. In a large city, a distance of two miles between two locations for a station may make a difference of 300 per cent in the interest charges on the necessary real estate. In Chicago, for example, the interest charge alone on real estate at 12th St., on which a freight station is located, is more than $2.50 per ton of freight handled through the station. If the station were located at 33rd St., such interest charge would be reduced to about 80c. per ton. The amount of interest saved by moving this station would pay the cost of well organized cartage between the 33rd St. station and the premises of the trader.

Under present operation, outbound freight is brought to the stations by whatever method and at whatever time the traders choose. Inbound freight is removed from the station in like manner on an average of about three days after its arrival. This necessitates using the railway station for storage, which would be unnecessary if collection and delivery service were controlled by or operated in co-operation with the railway. In this case a narrow roofed platform having tracks on one side and a highway on the other would meet every need. The function of railroads is to furnish transportation, not storage, which rarely is profitable to the company and seriously interferes with its legitimate functions.

With few exceptions, freight stations in large cities are now so congested that unless more traffic can be passed through them or, by extravagant expenditures, they can be enlarged or multiplied, the roads will be unable to handle the normal increase in freight traffic.

The Railway and the Highway—Complete transportation of goods by either highway or railway alone can be furnished only in limited fields. Although most industries and residences are connected with each other by highways, such transportation is economical only when limited to a distance, placed by competent truck experts as anywhere between 25 and 150 miles. Under emergency, longer hauls may be justified for highway traffic, but these are negligible in considering the whole field.

On the other hand, comparatively few industries and practically no residences are connected with each other by railways. The field for complete transportation of goods by railway is restricted therefore to the movement of carload freight between industries having direct rail connections. An example of this is the movement of coal from a mine to an industry located on a side track.

Competition—In this country, parcel post, the express company, the railway, and the trucker all are competing for the transportation of the same goods. Although the parcel post and express are transported over railways, the government and the express company compete with each other and with the railway for the carriage of packages weighing 70 lb. or less; and the trucker competes with the other three agencies.

Competition for the local carriage of goods within city and suburban areas should be welcomed by the railways as they perform this service at an actual loss while the trucker can do it at a profit. On the other hand, competition with the railway for the carriage of goods to rural districts along main lines of railways is harmful to the railway and unprofitable to the trucker.

Co-operation—With the parcel post there is complete co-operation between railways and highway transportation as the government has its own cartage system. The same is true for the express company. For freight traffic, however, there is hardly any co-operation between the railways and the motor truck. Unless there is a radical change from present practice in railway transportation in the United States, our transportation system will become a hindrance to the development of this country.

Five years ago when the railway system was placed under federal control its progress was halted and it has never regained its stride. Development has not kept pace with industrial development, as net revenues have not been sufficient to attract the capital needed to finance normal additions and betterments to road and equipment. Although existing rates are not high enough to produce the net operating income to which the Interstate Commerce Commission has determined the railways are entitled, the tendency is to reduce rates with no reasonable hope of increasing them.

Inadequate Terminal Facilities—The limitation on the

traffic the railroads can move is a matter of terminal facilities. These cannot care for the traffic that could easily be transported over the main lines of the railways. Under existing rates, the line haul of freight would be highly profitable if the revenue were not absorbed by increasing terminal expenses. If the railways are to remain solvent, therefore, and carry the traffic for which transportation is demanded they must find a way: first, to reduce terminal expenses, and second, either to enlarge their terminal facilities or to pass more traffic through the existing facilities.

The Present Evils—This is the most important problem before the American people, and it can be solved only by remedying the following evils: (1) Too low compensation to the railroads for carrying parcel post and express matter on passenger trains; (2) Lack of organized collection and delivery service, making necessary unreasonably large and costly freight terminal facilities and an unreasonably large supply of freight cars; (3) The use of box cars for the transfer of l.c.l. freight between railway stations and large terminal areas (this could be done more economically by trucks, releasing thousands of box cars from unprofitable service and substantially increasing the carrying capacity of the railways); (4) The use of box cars as trap-cars for moving l.c.l. freight through terminal areas for industries that have rail connections and the absorption by the railways of trap-car, subway, and lighterage expenses, which is equivalent to furnishing free cartage to the favored few large traders in discrimination against the average trader who is obliged to provide his own cartage; (5) The operation of branch lines on which the traffic is too light to sustain railway transportation and which could be better served at less expense by the motor truck.

Advantages of Co-operation—The most important field for co-operation between the railway and the truck is the collection and delivery of l.c.l. freight in large cities. Comparatively few trucks are now used, first, because there is no co-operation between the truckers, and second, because there is no co-operation between the truckers and the railways. Under present conditions the delay through handling freight at railway terminals makes the use of motor trucks unprofitable, so most of the service is performed by horse-drawn vehicles. Trucks are profitable only when they can be kept moving most of the time. No single road, moreover, handles freight to and from every part of a large city in sufficient volume to make profitable its collection and delivery by a trucking organization. The combined l.c.l. freight of all the railways in a city, however, could be collected and delivered by a properly equipped trucking organization at less cost than now paid by the traders for cartage and still yield a profit to the trucking company.

In the principal cities of Canada the railways handle collection and delivery under separate cartage tariffs and the president of one of the largest of them has stated that his railway could not possibly handle its traffic through present terminal facilities without this service.

In the United Kingdom the railways handle collection and delivery at practically all their stations. The chief executives of several British railways have expressed the following conclusions: First, that in terminal cities and large industrial centers the collection and delivery of freight by a single trucking organization is absolutely essential to the most efficient operation of freight stations, and that with the co-operation of such a trucking organization, the railway company may control the time of collection and delivery of freight. It is enabled thereby to operate its stations throughout the 24-hr. day if necessary and to use the same platforms and forces for handling inbound and outbound freight. Second, that collection and delivery can be furnished under a separate tariff at rates high enough to produce an actual profit from the cartage operations after paying all expenses, and low enough to induce 95 per cent of the traders to use the organized collection and delivery service, rather than perform it themselves. Third, that in England, where the general conditions are substantially like those in New England, the railways and the traders have prospered under unified cartage systems without any substantial additions to station facilities.

American and British Systems Contrasted—Contrast the operations of a large terminal freight station in the United States with a typical British station. In this country inbound freight is handled over one set of platforms by one working force and outbound freight over another set by another working force. Each of these is operated through the entire business day. The inbound platform is piled with freight awaiting delivery, interfering with the movement of freight across the platform. When the inbound cars are unloaded they must be pulled out of the station and set into the outbound station for loading the following day.

In a typical British station the same platforms are used for handling not only the inbound and outbound traffic, but also a third class of traffic, and they are operated throughout the entire 24-hr. day. When the day force goes on at 8 a.m. cars loaded with inbound freight stand on one side of the platform and a line of trucks or "lorries" is backed up at the other side. The city is divided into districts and the freight for each district is loaded into one or more lorries, there being more of these at the platform than there are districts. When a lorry is fully loaded a driver is summoned by telephone from a nearby stable. He brings a heavy Clydesdale horse and drives away with a three-ton load to the proper district where he makes delivery. An empty lorry is backed in the place of the one that has left, which in turn is loaded and driven away.

Before noon all inbound freight has been removed from the cars and delivered. At 1 p.m. the station platform is clear and ready to receive outbound freight, which is collected and delivered by the same drivers who deliver the inbound freight in the morning. Before 5 p.m. all outbound freight is collected, loaded into cars, and dispatched before midnight. The platform is then clear and ready to receive the heavy fish and vegetable traffic which begins to arrive at 1 a.m. and is delivered to the market before 6 a.m. At 8 a.m. the platform is again clear and waiting for inbound merchandise.

In this country demountable truck bodies or trailers doubtless would be used instead of the British lorries, and tractors would be substituted for the horses. On our platforms we doubtless would use four-wheel trailer trucks drawn by electric tractors, instead of the two-wheel trucks used in Great Britain. With American methods applied to the British system of collection and delivery, much greater efficiency would be obtained and better service would be rendered than is now rendered there. In London, three of the great English railways have combined their collection and delivery service with satisfactory results, the manager of the combined service declaring that if all the roads reaching London would join in the combination even greater economies could be effected.

The average railway manager in this country fears to encourage the establishment of this service because of the danger that the railway will be required to pay its cost, and thereby increase terminal expenses. This service should not be forced upon the trader but rather be offered to him under a separate cartage tariff at rates that would be less than present cartage expense.

Collection and Delivery of Carload Freight—A second field for co-operation between the motor truck and the railway is the organized delivery of carload freight from public team-tracks in large terminal areas. This freight is now handled at the expense of the trader, who is allowed from two to five days within which to unload cars after he has received notice that they are ready.

Generally speaking, there is a shortage of team tracks in the central districts of large cities and it is next to impossible to build more. Cars must be held in the outer yards until there is room for them and then they must be held on the team track until it is convenient for the trader to unload them. This means that large terminal districts are full of idle cars, and the average time that box cars are delayed at the Port of New York and in the switching district of Chicago is ten days per trip. If all cars that carry loads into New York, Chicago and other large terminal areas could be unloaded and loaded out on the day of their arrival or on the following day, the present freight-car

equipment of the railways would be sufficient to meet all transportation needs for several years to come. Competition between railways in according privileges to traders has crippled freight-car supply and thereby has injured the trader more than he is benefited by the allowance of an unreasonable unloading time.

A new system of delivering carload freight must be adopted, and it will require the co-operation of railways, truckers, traders, warehouse men, Interstate Commerce Commission, and state utilities commissions. Free time for holding loaded and empty cars for the convenience of traders should be modified to insure unloading of cars within 24 hr. after they are ready and loading within 24 hr. after they are placed. This would deprive the trader of a substantial amount of free storage and require him to pay warehouse charges on inbound freight that he is unable to receive on the day of its arrival. These disadvantages, however, could be to some extent offset by cheaper cartage furnished by an organized collection and delivery service, and the warehouse charges might be reduced substantially by co-operation between railways, truckers, and warehouse men. The average time required by a freight car in carload freight service to make a round trip is about 20 days. Of that time, the car is actually moving in line haul, loaded or empty, only 2.2 days, and it is actually earning revenue only 1.5 days.

Branch-Line Service—Another field for profitable use of the motor truck is transportation of freight between communities served by branch lines of railways on which traffic is too light to pay expenses. These lines were built before motor transportation was perfected. They have performed a necessary public service but have outlived their usefulness as the transportation can now be performed better and more cheaply on the public highways. In several cases in which railways have contemplated branch lines, they found they could better afford to establish their own truck service, and the proposed branches have not been built. All such losing branch lines along which transportation by truck over existing highways could be furnished at less expense should be abandoned, and better and less expensive truck service substituted by the railway company if the truckers will not occupy the field.

Who Will Benefit?—Five parties are interested in these changes: The general public would be benefited in that the city streets would be relieved from the congestion caused by wagons and trucks carrying small lots of freight to and from the railway stations. The new rural highways would last longer as the co-operation of railway and truck would put an end to long-distance trucking. The trader would get better service at less cost. The motor-truck industry and the truckers who would co-operate with the railways would increase their field for profitable operation. The warehousemen would profit by the addition of the storage now furnished by railways. Railways would cut down terminal expenses and increase capacity for service.

The trucker has an advantage over the railway in that highways are constructed by the general public through taxation, while the railway is constructed at the private expense of the railroad company. In the early history of the country public lands and moneys were contributed to a few railway companies to promote the building of railways, but such donations have long since been repaid by the enhancement in the value of taxable property resulting from the operation of the railroad.

The railroad pays through taxation a large share of the cost of building and maintaining highways, while truckers pay no part of the cost of building and maintaining railways. If the trucker is to compete with railways, either he should pay a substantial part of the cost of constructing and maintaining highways, or the railway should be relieved of taxation for highway purposes.

If, however, the trucker would take over that part of transportation now performed by the railway at an operating loss, on which he could make a reasonable profit; and, second, would cease to compete with the railway for the traffic that the railway can carry at a profit, on which the profit to the trucker is very doubtful; and third, would co-operate with the railway in handling traffic which requires transportation both by rail and highway—in other words, if the truck would supplement the railway service instead of competing with it, it would be to the interest of the railway that the expenses of the trucker should be reduced to the lowest limit. Then the railway could well afford to pay substantial taxes for highway purposes and offer no objection to the free use of the highway by the trucker.

There is a steady growth of public sentiment in favor of imposing upon the trucker a more substantial part of highway expense, which, it is said, is caused by heavy trucks. If the public is satisfied that the truck is used only where a railway could not furnish so good a service, the public would cease demanding that greater burdens be placed upon the trucker.

Diversity of Problems—No scheme of operation will fit all terminal situations. The New York situation demands the use of motor trucks with demountable bodies or trailers to move the freight by way of ferries and city streets between railway terminals on the New Jersey shore and inland, offtrack stations in the various industrial centers of New York. By the use of ferry boats and inland offtrack stations, instead of freight cars on car floats, the railroad would be able to release large holdings of valuable dock property for the docking of ocean steamships. The inland stations could be constructed on less valuable property, and if used jointly by all railways and steamship companies would offer possibilities of joint warehouses and industrial buildings.

Real estate men are ready to undertake to secure sites for such stations in all parts of New York and to construct thereon buildings in which the first floor would be adapted for railway stations. They would be willing to guarantee that the station floors would be leased permanently to the railway companies at nominal rentals, on condition that the occupants of the upper floors might have access by elevators to the station floor for the receipt and delivery of freight without expense for cartage. An organized truck service would substantially reduce the traffic now passing through the streets of New York and the cost would be much less than the cost of the present car-float operations.

The Chicago situation is more complex. The distances are so great and the railway systems so completely cover the city that railways must supplement the truck service for long-distance movement.

In Cincinnati an organized truck service is in operation to handle most of the transferring of freight between the city stations of all the railroads centering there. All stations are equipped with machinery for handling loaded and empty five-ton demountable truck bodies, which are loaded and unloaded on the station platforms and moved on chassis under the control of a dispatcher. This station-to-station service could easily be extended through the industries and some of the largest traders in Cincinnati have requested such service.

At St. Louis, organized motor-truck service with trailers and semi-trailers has long been in operation between the freight stations at East St. Louis and inland stations in St. Louis. This service conforms closely to that outlined for New York, except that the trucks cross the river on bridges instead of ferries.

At St. Paul and Minneapolis, the Great Northern and Northern Pacific Rys. for many years have used large box cars at freight stations for outbound l.c.l. freight in different parts of both cities. When the cars are loaded they are switched to a common transfer station about half-way between the Twin Cities where the freight is transferred from the station cars to line cars for any destination on either railroad.

The Chicago, Milwaukee & St. Paul Ry. uses a similar service in the Twin Cities. The president of that road has said that by substituting that service for the separate stations previously used in each city, his company had been able to move its increasing freight traffic with 40 per cent less cars than were previously required for movement from separate stations in each city.

In each city there is a practical solution which, with the

full co-operation of railways and trucks, would result in the movement of freight through the city stations more promptly and thus enable the railway to furnish much more transportation service without increase of facilities and without increasing transportation charges.

Summary—Trucks should supplement the railways and not compete with them. Wherever complete transportation can be furnished by the truck more efficiently and cheaply than by the railway, the truck should be used. Wherever the railway service is adequate and profitable and less expensive than truck service, the railway should perform the service. Where the best and cheapest service can be furnished profitably by the railroad and truck combined, the railway and the trucker should co-operate in furnishing that service. The railway and the truck should keep out of each other's special territory and less expensive service.

Concrete Alley Paving Practice in Milwaukee

Rich Dry Mixture Required—All Aggregate Passes a One-Inch Ring—Tamped Surface Finished With Dry Mortar Floated In

CONCRETE pavement for alleys has been developed by superior construction to a high degree of serviceability, at a moderate cost, by the Milwaukee Department of Public Works. In 1921 pavement of the section shown by Fig. 1, and of 1:2:3 concrete, was laid at an average price, for 147 blocks, of $1.80 a square yard. This price includes a longitudinal joint, with a bituminous filler; transverse joints, with filler, at least every 25 ft., and joints, with filler, where the sides come against masonry building walls or where telephone poles or similar obstacles have to be encircled by the concrete. With a moderate demand at first, householders are now putting in applications for alley pavements more than twice as fast as the bureau of streets can construct them.

A high quality of construction has been laid down as the first requirement. In no respect are the engineers of the department or the contractors who do the work permitted to consider alley concreting as second-class paving. Indeed, the specifications for materials and workmanship are quite as exacting as for concrete pavements for main-traffic streets. A three-year guarantee is demanded of the contractor against defects due to improper materials or inferior workmanship. Only the best sand and coarse aggregate are allowed, the consistency is rigidly controlled and the rules for finishing are precise and exacting.

As shown by Fig. 1 the pavement slab is dished transversely and is separated longitudinally by a filled joint along the center line. Instead of a uniformly thick slab, which is the more general practice, the two halves of

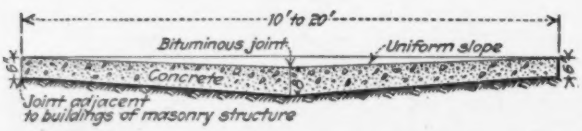


FIG. 1—SECTION OF CONCRETE PAVEMENT FOR ALLEYS, MILWAUKEE, WIS.

the slab taper from 8 in. at the center joint to 6 in. at the edges. This is a heavier pavement than is common for alleys where usually the traffic is light and the speed of vehicles is slow. With the rather poor soil and not very good subsoil drainage in Milwaukee, this heavier

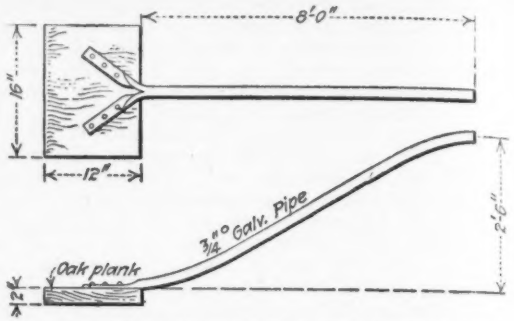


FIG. 2—FLOAT FOR WORKING DRY MORTAR INTO SURFACE

pavement was considered wise. Besides the longitudinal center joint there are transverse joints every 25 ft., and, as stated, a joint filler is used where the pavement abuts building walls or where manhole tops, poles or other structures project through the pavement.

Alley pavements are 10, 15 and 20 ft. wide in Milwaukee, which, with the joint arrangement indicated, give a structure of rather small, separate slabs and a correspondingly large latitude for expansion. Cracking has not been entirely avoided by this construction but on the whole there are very few cracks of serious characteristics. The required thickness of joints is ½ in. The transverse joints are fiber matrix and bitumen and the longitudinal joints are either the same construction or a bitumen filler which will not flow in hot weather or become brittle in winter.

A rich, dry mixture, with small-size and an especially clean, well-graded aggregate is insisted upon. A coarse washed sand is used and if the coarse aggregate is gravel it has to be washed and screened. All aggregate must pass a 1-in. round ring and no more than 5 per cent of the coarse aggregate may pass a quarter-inch screen. A one-minute mix is required and a dry mixture is absolutely demanded, one that requires vigorous tamping to bring the water to the surface.

In placing the pavement, the subgrade is brought to the exact profile shown by Fig. 1 and when any fill is required it is rolled with a 10-ton roller or tamped with a 50-lb. tamper having a face not exceeding 100 sq.in. The concrete is placed between a center and side forms and surfaced, with a strike-board, one side at a time, using the forms as guides. A finishing operation follows which is a special feature of practice in Milwaukee.

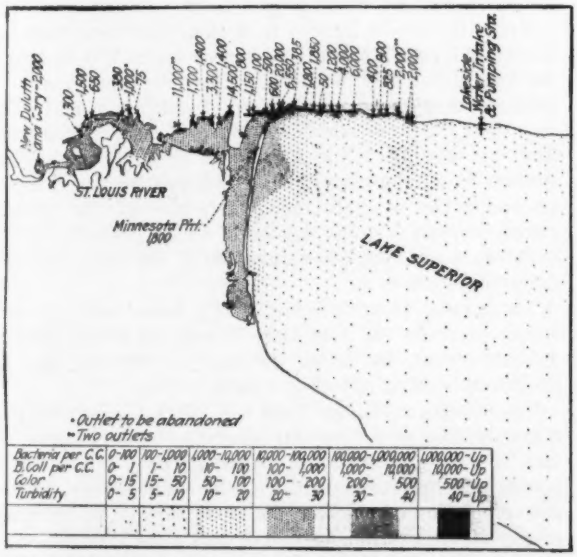
When the slab has been brought to the proper contour with the strike-board, it is tamped, using a 12 x 16 x 2-in. wooden tamper with a 1½-in., 4½-ft. handle. The tamping is continued until the water is flushed to the surface. Then a 1:1 mixture of cement and sand—all passing a No. 8 screen—is evenly spread over the surface in an amount sufficient to absorb the water. This surfacing is then floated, with floats constructed as shown by Fig. 2, until the dry mortar is thoroughly incorporated with the concrete. At least one sack of cement is used for each 30 sq.yd. of surface. If this does not absorb the water, another coat is applied.

Altogether the surface is gone over five times with the float, until at the last floating the mortar top is pasty and adhesive and is slightly drawn along with the float.

Filters for Duluth Water Supply Considered Unnecessary

Intensive Investigation by State Board of Health Engineers Indicates Filtration Not Warranted at Present

FOR nearly two years sanitary engineers and water analysts of the Minnesota State Board of Health have been investigating the water supply of Duluth, Minn. The principal fact to be determined was whether chlorinated water from Lake Superior 1,500 ft. off shore in 60 ft. of water and 8½ miles from the center of the main business section is safe or whether it would be advisable to install filters, to improve storage or distribution methods or to make changes in the treatment or disposal of the sewage. While definitely stating that it is not against filters the board goes on record with the statement that the expense is not now warranted.



RESULTS OF DULUTH WATER AND SEWAGE SURVEY

Figures at the top show the position of sewer outlets and the tributary population. In the table at the bottom is indicated the amount and character of contamination.

The board has been watching the supply for 12 years and several recommendations for improvement have been made. A hypochlorite plant installed at the board's request in 1912 was replaced by liquid chlorine in 1916. A city laboratory was established in 1921 but analyses have been carried on since 1912 in the branch laboratory of the state. The Edison reservoir is being covered to prevent dust contamination. Emergency intakes and cross-connections with other sources have been eliminated.

The present survey consisted in sampling the water from selected points 2 miles apart in the western end of Lake Superior and from the St. Louis River to determine the extent of the pollution from sewers. Sanitary conditions at the various sewer outlets were also investigated. The accompanying map shows the extent of indications of contamination. Analytical data of raw and chlorine-treated water at the Lakewood pumping station show conclusively, states the board, that indications of contamination are removed and that the water comes within the limits fixed by the U. S. Treasury Department. Filtration would only reduce the normally low turbidity to zero.

No very definite conclusions as to the permissible nearness of the sewer outlets to the intake are established by the board but the statement is made that the city would be acting on the side of safety to permit no sewer outlets within 3 miles of the intake. Other definite recommendations rising out of the survey are as follows: Watertight covers for reservoirs; a traveling, self-cleaning screen for the intake well; transportation for the bacteriologist to permit him to investigate all parts of the system; a temporary auxiliary chlorine plant until the only one of the reservoirs uncovered is covered; investigations to be continued indefinitely; disinfection of new mains; separation of parallel water mains and sewers by at least 6 ft. of compact earth; extension of 15 sewer outlets immediately and 9 soon (the remaining 13 are satisfactory). The work was carried out under the general direction of H. A. Whittaker, director, Minnesota State Board of Health, by J. A. Childs, engineer.

Court Denies City's Right To Condemn Power Source of Another City

A DECISION handed down in California Nov. 6 by the United States Circuit Court of Appeals establishes a precedent that will have an important bearing on future legal conflicts over water or power sites between two municipalities or between a municipality and a privately owned public utility. The suit was brought by the City of Los Angeles which sought to condemn for its own uses a power site on Owens River already partially developed by the Southern Sierras Power Co. and used for supplying power to communities in the southeastern part of the state. This company does not serve Los Angeles, nor do its transmission lines pass nearer than sixty miles from the borders of the county.

The decision was written by Judge William W. Morrow and reverses a decision of the United States District Court rendered in July, 1921, by Judge William C. Van Fleet. The lower court held that the City of Los Angeles had a superior interest in a power site comprising 320 acres and extending a mile along the river in that portion known as the Owens River Gorge and had fixed the condemnation price at $525,000.

In reversing the lower court the Circuit Court held that "property of a private corporation appropriated to the public use in one county may not be appropriated to a public use by any other county or city and county while such property is so appropriated and used." The decision stated, further, "the question we have to determine is not whether the City of Los Angeles has the right to condemn the property of a private corporation appropriated to a public use in the service of the City of Los Angeles and its inhabitants, but whether the City of Los Angeles has the right to condemn the property of a private corporation appropriated to the public use of some other county, municipality, incorporated city and town and inhabitants thereof."

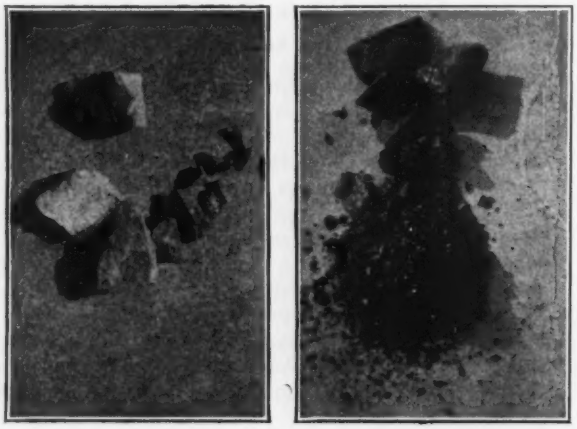
The decision of the higher court fully upheld the contention of the Southern Sierras Power Co. that the needs of six counties and numerous cities and towns throughout the southeastern portion of the state, served by this company, are equally as important as the needs of Los Angeles.

Testing Sprinkling Filter Stone by Freezing and Thawing

Limestones Practically All Disintegrated Rapidly After 34 Alterations in Temperature —Granite Unharmed

INVESTIGATIONS on the durability of stone available for use in the sewage sprinkling filters now under construction at Lincoln, Neb., have been made by alternately freezing and thawing the material. An attempt was made to approximate conditions to which the stone in the filters would be subjected. Samples after a thorough soaking in water were placed in a cold storage house where a temperature of 8 deg. F. was maintained. Every morning the stone was thawed out with warm water, then cooled down with cold water and returned to the cold room. The samples were alternately frozen and thawed 34 times. The following results were obtained:

A sample of stone from one quarry at Louisville, Neb., was dark blue in color and somewhat porous



STONE FROM QUARRY NO. 1, LOUISVILLE, NEB., BEFORE AND AFTER FREEZING AND THAWING

in appearance. It was broken to such a size that all pieces would be retained on a ¾-in. screen. At the conclusion of the test 56 per cent was retained by a ¾-in. mesh; 19 per cent was retained on a 4-mesh screen and 25 per cent passed a 4-mesh screen. Had the test been carried on further probably all of the stone would ultimately have disintegrated almost to a powder.

From a second quarry near the one noted above, at Louisville, Neb., a pure white stone, not overly porous, is obtained. The sample could be considered an average or above average one as regards the entire face of the quarry. This is the same stone which was used in the sprinkling filters at Broken Bow, Neb., and at Harvard, Neb. The stone was broken to such a size that it was retained on a 1½-in. mesh screen. At the conclusion of the test the stone had disintegrated so that only 27 per cent was retained on a ½-in. mesh screen, 25½ per cent passed a 1½-in. mesh screen and was retained on a ¾-in. mesh screen, 36.1 per cent passed a ¾-in. mesh screen and was retained on a 4-mesh screen and 11.4 per cent passed a 4-mesh screen. This stone would undoubtedly have continued to go to pieces if the test had been carried out for a longer time.

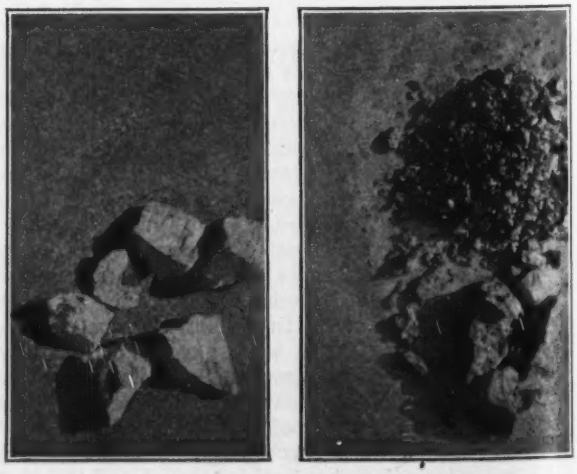
The method used in testing these stones is shown to be a fair one by an examination of the stone in the filters at Broken Bow and at Harvard. Each of these filters has been subjected to exposure for two winters. The stone is badly disintegrated and will undoubtedly need replacing within the next few years. The stone is splitting apart exactly as occurred in the tests under discussion. The filter at Harvard shows identically the same condition as exists at Broken Bow.

The sample from a quarry near Weeping Water was obtained from the upper ledge, having a thickness of about 9 ft. The stone was broken to such sizes that 52 per cent would pass a 5-in. mesh screen and be retained on a 3-in. mesh screen. About 30 per cent would pass a 3-in. and be retained on a 1½-in. mesh screen and the balance would pass a 1½-in. mesh screen and be retained on a ¾-in. mesh screen. After the test 52 per cent would pass a 5-in. mesh screen and be retained on a 3-in. mesh screen, 28.4 per cent would pass a 3-in. mesh screen and be retained on a 1½-in. mesh screen, 15.2 per cent would pass a 1½-in. mesh screen and be retained on a ¾-in. mesh screen, 2.7 per cent would pass a ¾-in. mesh screen and be retained on a 4-mesh screen and the balance or 1.7 would pass a 4-mesh screen.

From the above figures it is clearly evident that the Weeping Water stone disintegrated much less than did the ones previously discussed. However, the figures do indicate that there was a loss of 4.4 per cent in the weight of the stone which would pass a ¾-in. mesh screen. The loss seemed to be a gradual chipping off of the surface of all the pieces, while the smaller pieces broke up somewhat by splitting apart, one of the largest stones showed a crack across it which probably would have caused a complete separation if the test had been carried longer.

The gravel from Meadow, Neb., tested was of such a size prior to the test that it was all retained on a 4-mesh screen, but after the test 7½ per cent had so broken up that it passed a 4-mesh screen.

The sample of Sioux Falls (So. Dak,) quartzite had a granite-like structure and seemed to be very dense. It was of such a size that it would all pass a 3-in. mesh screen and be retained on a 1½-in. mesh screen. Upon the completion of the test the stone showed no evidence of any disintegration. Stone of this same type although not from the same quarry was used in a sprinkling filter at Geneva, Neb., where it has been in use for two winters. An inspection of this filter disclosed no change in the appearance or size of the stone.



STONE FROM QUARRY NO. 2, LOUISVILLE, NEB., BEFORE AND AFTER THIRTY-FOUR FREEZES

PARTIALLY DISINTEGRATED STONE IN SPRINKLING FILTER AFTER TWO WINTERS' EXPOSURE

Red sandstone from Lyons, Colo., was used in a filter at Minden, Neb., and an inspection of this filter recently made showed that there is a slight disintegration due to the splitting of the stone along cleavage planes. This indicates that any stone in which cleavage planes are well defined will not stand up under alternate freezing and thawing.

From Ernest Boyce, assistant engineer, Kansas State Board of Health, it was learned that the sprinkling filter stone at Neodosha and Newton was standing up satisfactorily. The Newton rock was secured from a limestone quarry at Moline, Kan. For the Neodosha plant a blue-gray limestone was obtained from the city quarry 2 miles from town. In 20 or more contact beds in Kansas hard limestone and flint rock are the most common materials used and are satisfactory in most cases, but the softer limestones disintegrate somewhat.

Iowa plants use Sioux Falls granite and limestone. The first is approved by the State Board of Health. H. V. Pedersen, civil and sanitary engineer, indicates that it is entirely satisfactory. It is his opinion that cities should be allowed to use limestone if they thoroughly understand that the limestone may need replacing every 10 or 15 years and it is found cheaper to do this than to ship in granite. Limestone in use 6 years at Mason City, the largest plant in the state, shows some disintegration but will last many more years, in the opinion of Mr. Pedersen.

All the trickling filters in South Dakota have used Sioux Falls quartzite according to A. H. Wieters, director of the division of sanitary engineering of the State Board of Health, the quartzite in the Aberdeen filter plant having been in use for 8 years without any indication of disintegration.

It is probable that the Sioux Falls quartzite will be used in this filter inasmuch as climatic conditions in Nebraska are similar to those in North Dakota and Iowa, where the winters are often severe. The plant will be completed next spring ready for the reception of the stone, of which 33,000 tons will be required.

The tests and investigations were made by Grant, Fulton and Letton, engineers, Lincoln, Neb., who are associated with Alvord, Burdick & Howson, engineers, Chicago, in the design and construction of the sewage disposal plant.

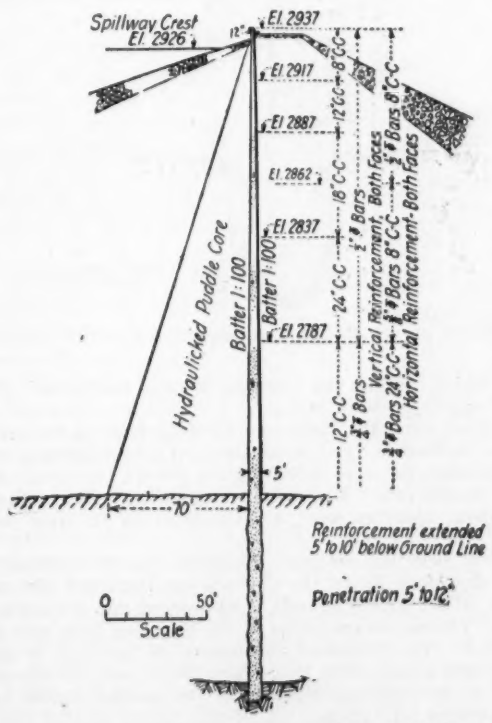
Core Walls for Dams of the U. S. Reclamation Service

Description of Five Core Walls Including a Combined Concrete and Puddle Wall in New 220-Ft. Tieton Dam

Extract from Paper by C. H. Howell, Engineer, U. S. Reclamation Service, Denver, Colo., in the August "Reclamation Record"

THE masonry core walls built by the U. S. Reclamation Service are all of concrete and in general are comparatively thin sections. The highest in service at the present time is in the Strawberry Dam, Strawberry Valley Project, Utah. The maximum section of this wall is shown in the accompanying illustration.

The Tieton Dam, Yakima Project, Washington, now under construction will be the highest earth dam built by the Reclamation Service. It will be an earth-and-rock fill section, approximately 220 ft. high with both a concrete core wall and a hydraulicked puddle core. The puddle core will have a maximum width of 70 ft. at base of dam. It will be placed against the upstream face of the concrete core wall. The concrete portion of the core wall extends to a maximum depth of about 100 ft. below the river bed. In general it will be founded on andesite, although a small portion will rest on shale. A minimum penetration of 5 ft. into both shale and andesite is specified which is to be increased, if necessary, according to the character of the material which may be encountered. Where the foundation is in shale the

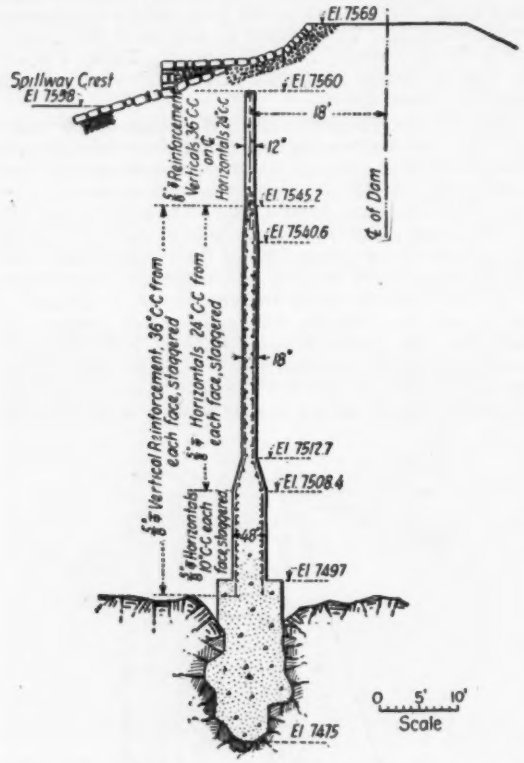


COMBINED CONCRETE AND PUDDLE CORE WALL TIETON DAM

footing will be spread out to limit the pressure due to the weight of the wall itself to 8 tons per square foot. The reinforcing of the spread footing will consist of 20-lb. rails on 12-in. centers. On andesite the maximum thickness will be 5 ft. The design of the maximum section is shown in the drawing.

Only two dams have been constructed by the Reclamation Service with puddle cores in the strict sense of the term and these were constructed by hydraulicking. The Conconcully Dam on the Yakima Project was constructed by the

hydraulic method, but as the fill increased in height it was found impossible to secure a central impervious portion of sufficient thickness due to the decreasing percentage of fines and the narrowness of the pond. Loam therefore was borrowed from the valley floor and then sluiced into place between wooden forms which were placed to prevent strata of sand being washed in from the other material. This puddle core is 8 ft. thick at its base 14 ft. above the base of the dam; the thickness at its top is 5 ft. In section this core is not vertical, but slopes upstream about 30 ft. from



MAXIMUM SECTION CORE WALL STRAWBERRY DAM

its top, which is under the upstream edge of the crown. Its vertical height is about 40 feet.

The Bumping Lake Dam was built by hauling the material on to the dam, then separating and consolidating it by hydraulicking, the fines being sluiced toward the center to form a puddle core. The puddle was built by this method up to about spillway level, a distance of 50 ft. from the bottom.

At this elevation similar difficulties in the hydraulic method developed as on the Conconcully Dam and the remainder of the puddle material was dumped and worked by shovels. The maximum height of the Bumping Lake core is about 60 ft. The horizontal dimensions are variable; in the hydraulicked portion they range from 20 ft. near the bottom to 2 ft. at the spillway elevation. The portion placed by hand averages 4 ft. thick.

The core walls and puddle cores constructed by the Reclamation Service have proved adequately tight, and so far no trouble due to saturation has developed in the upstream portions of the dams in which they are built. Somewhat extended reading indicates that the above is generally true of other well designed and constructed dams. Both types have been in service for years and doubtless will continue to be used in the future, offering practical and economical solutions when more theoretically correct sections are not feasible.

A most unusual core was built in the Sherburne Lakes Dam by the Reclamation Service as a part of the drainage system of the dam. This drain consists of a core of screened gravel, 5 ft. thick at the top, 10 ft. thick at the bottom and about 83 ft high, with side slopes of 3:100. This core is placed approximately under the downstream edge of the crown and extends the full length and height of the dam. The most impervious material in the dam is placed above the core and the coarser below. A cast-iron pipe with open joints is laid in the bottom of the core and connects with transverse discharge drains, which lead back into the stream. This construction thus far has proved satisfactory, although it has not yet been thoroughly tested, having been subjected to a head of only 45 ft. while the design is for 68 feet.

New Standards for Municipal Employment

Abstract of a report submitted to the National Municipal League on Nov. 22 by its Committee on New Standards of Municipal Employment, W. E. Mosher, secretary.

THE chief recommendation of the committee is that there should be centralized employment supervision and control in the public service and that the civil service commission is the natural agency to perform this function.

On the ground that co-operation, the basis of sound personnel administration, has not been realized between the responsible officials and the typical civil service commission, and further that it is not likely to be realized under the present system, the committee recommends that the civil service commission itself be reconstituted, as follows:

1. That a single civil service commissioner be appointed with indeterminate tenure of office.
2. That the mayor (or commissioner or city manager) appoint the commissioner from an eligible list of three, which list results from the competitive examination given by a special examining board to candidates qualifying as employment managers.
3. That the examining board consist of three persons, all of whom are experienced in employment management and at least one of whom must have been or be an official of a civil service commission.
4. That one of the members of the examining board shall be named by the mayor, one by the local superintendent of schools and the third by the first two.
5. That the salary of the commissioner be commensurate with the salaries paid other administrative officials performing comparable functions.
6. That the appropriations for the work of the commission be materially increased, so that the commissioner may have a staff qualified to co-operate effectively with the various administrators.
7. That removal shall be possible after the filing of charges and a public hearing before the executive.

The assignment of equal power to the superintendent of schools and the mayor in the appointment of the special board of examiners is due to the conviction that the superintendent of schools is the public official in the municipality who is most unlikely to be swayed by political considerations. It is believed that his co-operation in the matter of appointing the board will generally guarantee that considerable weight will be given to merit in the work of the board. The committee is also of the opinion that an employment specialist selected because of competency and accepted by the officials because of his contributions will probably further the interests of the merit system more than a partially outside body, such as the typical civil service commission, which is bi-partisan in origin, subject to continuous change, and untrained in handling employment problems.

Finally the committee recommends that the civil service commission bring about the appointment of personnel committees, consisting in equal parts of staff representatives and those elected by the rank and file of the employees. It is proposed that these committees should meet with and advise the civil service commissioner in the development of the employment policy and in the improvement of the standards of public service. This recommendation is quite in line with recent developments in private industry, where it has led to a better spirit of co-operation and improved standards of efficiency.

[The full report will appear in "The National Municipal Review," published by the League at 261 Broadway, New York City.—EDITOR]

Progress Being Made in Study of Marine Borers

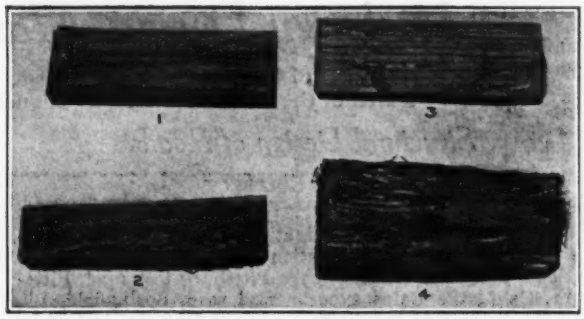
Committee of National Research Council Has Assistance of Government Bureau—Test Blocks Show Wide Prevalence of Borers

GOOD progress is being made by the committee on marine piling investigations of the National Research Council in its study of the marine borer. This committee has received a large proportion of its financial support from the railroads. Perhaps one-third of the voluntary work has been done by the engineering departments of the various roads owning or operating terminals on salt water. However, the federal government is now contributing considerable in the way of observations and investigations of actual conditions. The Coast Guard of the Treasury Department, the Bureau of Yards & Docks and the Bureau of Construction & Repair of the Navy, the Bureau of Lighthouses and Bureau of Fisheries of the Department of Commerce, the Forest Products Laboratory of the Department of Agriculture, and the Corps of Engineers and Quartermaster Corps of the War Department are all now aiding in the work. The Bureau of Yards and Docks, the Corps of Engineers, and the Bureau of Lighthouses have sent out exhaustive questionnaires designed to develop information as to previous experience with marine borers and with various methods of protection against them, as well as with concrete and other substitutes for wood.

Plan of Work—There has been found surprisingly little information as to the species of marine borers existing on the American coasts or the distribution of those that were known to exist or the rapidity with which they work. In order to devise means of protection and to know where the conditions are such as to render borer action probable, a system of test boards accompanied by chemical tests of the water has been designed. The test board contains a number of blocks and is hung overboard at sea-water stations on all coasts of the United States. One block is removed from the board on the first and fifteenth of each month and sent either to Harvard University, the University of California, or the American Museum of Natural History for determination of the species and the rapidity of their growth in various harbors. Of these boards 230 have been made.

The examination of blocks so far removed shows the presence of teredo navalis at Provincetown, Mass., Newport and Providence, R. I., Mystic, New London, South Norwalk, Westport and Guilford, Conn., West Sayville, Fire Island, New York Bay and Jamaica Bay, N. Y., Bayonne, Perth Amboy, Point Pleasant, Barnegat Bay, Beach Haven and Atlantic City, N. J., Norfolk, Va., and San Francisco, Calif. The rate of destruction by this species as shown by the blocks was greatest at Providence, R. I. Next in order of activity are the locations along the north shore of Long Island Sound, and along the New Jersey coast. The accompanying view shows the penetration of one of the blocks at a New Jersey station in less than two months' time.

Limnoria were found in test blocks all the way from York Harbor, Maine, to Mazatlan, Mexico, and in San Francisco. Bankia are present from Barnegat, N. J., clear down to Mazatlan, Mexico, and in San Francisco. Spaeroma have been found at Provincetown, Mass., Tampa Bay, Fla., and Pass Manchao, La. Teredo of



RAPID PROGRESSIVE ACTION OF TEREDO IN TEST BLOCK AT POINT PLEASANT, N. J.
Board installed Aug. 16, 1922; test pieces removed as follows: (1) Sept. 22; (2) Oct. 5; (3) Oct. 23; (4) Nov. 3, 1922.

species other than navalis have been found in test blocks and specimens in southern stations (Georgia, Florida, Texas, Virgin Islands, Cuba, Hawaii, and also in San Francisco).

Several of the species discovered are new to science and little, if anything, is known of some of the others. The first boards were placed in New England the first week in June and some others have been so recently placed that no blocks have been received from them. In another year the distribution of species should be fairly accurately known and the breeding season of the various species should be determined with considerable accuracy. It has already been found that teredo navalis breeds in Jamaica Bay, N. Y., as late as Oct. 1, which is much later than had been previously supposed.

The studies are being carried out under the direction of Col. W. G. Atwood, supervised by the committee of which R. T. Betts, of New York, is chairman.

European and American Transit Practice

From observation of European municipal transit conditions Daniel L. Turner, consulting engineer of the Transit Commission of New York City, stated before the New York Chapter of the American Association of Engineers on Nov. 14 that transit in the old world differs from ours physically, socially, and psychologically. Comparisons between transit conditions and methods on the two sides of the Atlantic are for this reason difficult. This applies to tram, bus, and rapid-transit (subway or elevated) practice. In particular, rapid-transit condition in New York City differ fundamentally from those found in any European city. With the most fully developed rapid-transit system in Europe, London serves only about one-fourth of its city area, and the total city area is less than one-third that of New York City (117 against 350 sq.mi.). Rapid transit is confined almost wholly to the northwest part of the city, about 40 sq.mi., while the New York system serves the entire city except Staten Island. Density of traffic is very much lower in European cities, moreover, and this is true of street vehicle traffic as well as of transit. Only in Paris is crowding of the rapid-transit trains as serious as in New York. Perhaps the controlling factor in establishing the difference between European and American transit conditions is the difference in building heights, the cities of Europe are generally of three to five-story heights, in the business as well as in the residence districts, and the tremendous concentration of rush-hour demand produced by the large office buildings of American cities is absent.

Highway Design, Maintenance and Finance

Abstracts of Committee Reports Made to the Advisory Board on Highway Research of the National Research Council, Washington, D. C., Nov. 23-24, 1922

Structural Design of Roads

By A. T. Goldbeck
Chairman Committee No. 2, Advisory Board on Highway Research

THE three principal investigations carried on for the purpose of securing information which would lead to the rational design of roads, are the Pittsburg test road, Pittsburg, Calif., the Bates experimental road, Springfield, Ill., and the Bureau of Public Roads experiments at Arlington, Va. In addition to these investigations, and as supplements to them, there are being carried on at the testing laboratories at Springfield, Purdue University, and the University of Maryland, investigations of fatigue of concrete.

Preliminary reports of fatigue investigations indicate that up to a certain per cent (about 50 per cent) of the ultimate load, concrete will withstand any number of repetitions of stresses, but beyond that percentage a definite number of loads will cause failure.

While the final reports of the Pittsburg, Bates and Arlington experiments have not been published, from preliminary observations it can be said that: (1) The least resistant part of the slab is the corner. (2) The position of the load which causes most serious stress in the slab is at the side edge, either at or near the corner.

It has not been definitely settled whether the greatest tension is produced in the top or the bottom of the slab. An unsettled question also is that of the impact effect of moving vehicles on the slab. We have information to show that under moving loads the actual deflection at one point is less than under the load remaining at rest at that point. This does not indicate, however, that the stress is less under the impact, since the area of distribution of the deflection might be different under impact and static loads. This phase is being investigated.

From the preliminary reports it would seem that the best way of increasing the strength of the slab without increasing the total amount of concrete would be to thicken the edges.

The point to be investigated is the determination of the relation of the center to the edge thickness so that the strength of the slab will be more or less uniform. The question of reinforcement also has not been settled, that is, should the principal reinforcement be longitudinal or transverse, and if it is better to have one layer or two layers, and, if one layer, where should it be placed, at the top or the bottom of the slab?

With this question of proper reinforcement is also concerned the strengthening of the corners. On both the test roads it was found that the corners were less resistant to traffic at night than in daytime, the reason for which (warping) has been frequently discussed. It is possible that proper reinforcement will considerably reduce this warping which we have reason to believe occurs in the main only very near to the corners. Proper reinforcement also will strengthen the corner by distributing the load to the adjacent slab. After the direction and position of the reinforcement have been determined, the next question to be settled is how this reinforcement should be distributed; for instance, if a certain section of steel is required, should it be all in one bar or will several bars answer the purpose better?

* * *

Gravel Road Surface Maintenance

By W. H. Root
Chairman Committee No. 7, Advisory Board on Highway Research

STUDIES of dust prevention and wearing surfaces on gravel roads interlock closely as all suitable wearing surfaces also act as dust preventives. The University of Michigan and the Michigan State Highway Department have just completed extensive research work with various bituminous surfaces and dust preventives for gravel roads. Their final report is being published. The work was done by G. C. Dillman, Deputy Commissioner of the Michigan State Highway Department, and Herschel C. Smith, Assistant Professor of Highway Engineering, University of Michigan, under the direction of Prof. A. H. Blanchard. Their preliminary report shows that experiments were conducted on three test roads having a total length of about 18 miles. Roads were chosen which carried a traffic of from 500 to 2,500 vehicles per day and which had from ¼ in. to 1½ in. of loose material on the surface. The test sections were one-half mile in length and the following materials were used:

High carbon tar, ½ gal. per sq. yd.
Special refined tar, light grade, ½ gal. per sq. yd.
Special refined tar, light grade, ¾ gal. per sq. yd.
Light oil, ½ gal. per sq. yd.
Heavy oil, ½ gal. per sq. yd.
Cut back oil, ½ gal. per sq. yd.
Cut back asphalt, ½ gal. per sq. yd.
Flake calcium chloride.
Granular calcium chloride.

The preliminary report gives the following conclusions:

1. Any surface treatment of gravel roads for dust prevention should extend the full width of the traveled way rather than over a portion of the center of the road, such as 16 feet.

2. For general use as a dust palliative on Michigan gravel roads, calcium chloride is the most satisfactory from the point of view of general applicability, application by unskilled labor and adaptability to various types and conditions of road. It is impossible, based upon these service tests of one season, to reach conclusions as to its effectiveness and economy compared with other dust palliatives investigated.

3. No distinction can be made between granular and flake calcium chloride as to effectiveness.

4. Calcium chloride supplied in the 100-lb. bag containers is more economically handled than that supplied in the 350-lb. metal drum and it appears that it might be profitable for the necessary storage to be provided so that this economy could be realized.

5. The use of calcium chloride has a tendency to cause the surface to pit and become rough, which slightly increases the cost of blade maintenance above that of a similar road on which calcium chloride is not used.

6. It appears that a light oil can be used on a gravel road even under a traffic of 1,500 vehicles per day, in case there is a sufficient amount of loose material on the surface to absorb at least 75 per cent of the oil.

7. Where the light oil is applied in a greater quantity than that which the loose material will absorb, it forms a thin glazed surface on the compacted portion of the road and the loose material which is quickly swept from the road cannot be successfully replaced as there is no tendency for material returned to the surface to adhere and become incorporated in the surface.

8. It is impossible, as yet, to standardize the use of light oil as a dust palliative for Michigan gravel roads because of the necessarily exact relation that should exist between the amount of oil applied and the amount of loose material. In no case should more than ½ gal. per square yard be applied and the amount should vary with the amount of loose material on the surface.

9. The heavier bituminous materials cannot be used for a dust preventive on Michigan gravel roads except as a material for forming a bituminous surface.

10. Regardless of the material used, a successful bituminous surface cannot be formed on a gravel road unless there is first a firm, even, hard surface on the gravel road which is free from loose material.

11. Bituminous surfaces formed within the limits of conclusion number 10 and with the materials and amounts used in these tests, do not disappear uniformly.

12. It appears that bituminous treatments made without top dressing and expected to disappear annually, although apparently satisfactory during the summer months when used on a high type gravel surface, will leave the road in such shape that succeeding treatments will be impracticable unless the roadway surface is reconstructed, and furthermore will impair the quality of the surface if it is to be maintained thereafter as an untreated gravel road.

13. It appears that it would be possible, however, to develop a bituminous surface, using a suitable metal top dressing on firm, even, hard, well cemented gravel roads.

Rhythmic Corrugations in Gravel Roads—The most extensive research work in connection with this most perplexing problem has been done by the U. S. Bureau of Public Roads. George E. Ladd, Economic Geologist for the Bureau, has written a report covering their investigations. Studies were made in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New Jersey, Michigan and Wisconsin. It was found that the distance from crest to crest averages about 31 in. and that the maximum height from the bottom of the trough to the top of the crest is 1¼ in. The causes of the corrugations are:

1. The kick back of surface materials arising from the spin of the rear wheels of automobiles as they descend after a bounce over some obstacle of depression.

2. From impact of both the front and the rear wheels of automobiles.

This latter class of corrugation is more prevalent when the clay condition of the gravel is high and especially where the gravel particles are well rounded. In the case of the first named corrugations, the location remains fixed. In the case of the second class they seem to swing on an axis located near the center of the road. In some cases the swinging movement was so great that corrugations which were originally at right angles to the road took a position only a few degrees from the axis of the road. Gravel roads subject to a traffic of not more than 200 or 300 cars per day remain practically free from corrugations, if occasionally dragged. As soon, however, as traffic reaches 400 or 500 cars per day corrugations develop very rapidly.

The fact that these corrugations are so general and occur in all sections of the United States makes it evident that nearly all gravel roads are subject to the development of this nuisance and menace, if they serve sufficient traffic, although the methods of construction and kinds of gravel vary widely. The situation, however, is not hopeless. Several highway officials have expressed the opinion that less corrugation trouble is found where the gravel is angular than where it is composed of highly rounded particles. It is also claimed that where the road is constructed of gravel more uniform in size than pit run, and especially where everything over 1 in. is excluded, that corrugations are slower in developing and more easily eliminated by maintenance methods. During the investigations in the state of Maine it was noted that roads with a relatively high per cent of clay-silt binder were comparatively free from corrugations.

* * *

Highway Finance Requires Research

By J. G. McKay
Chairman Committee No. 6, Advisory Board on Highway Research

HIGHWAY financing is typified by lack of agreement in methods and in the distribution of the costs of highway improvement between the sources of highway revenue. Neighboring states have entirely distinct systems of highway financing, and as a whole, fundamental principles of public financing are neglected. No uniformity of principles exist *due largely to the lack of evidence upon which to build rational systems of financing.*

During the past years distinct opposition to the growth in the yearly highway bill has developed.

The current criticism of the large sums raised for the improvement of the public highway system is a criticism of the inequalities and unfairness of the present methods of financing rather than a criticism of the amount of highway funds expended yearly. The public is not questioning the amount raised, but who ought to pay and how much.

The question which must be answered according to principles of equity is: *What percentage of the total highway revenue shall be raised from each of the sources of highway funds?* The problem is not whether a given state should make use of credit or raise funds from current revenue; it is how much of the total highway bill property owners and motor vehicle owners should contribute. The solution depends largely on the results of research, and research should be along the following lines:

1. A survey of present methods of highway financing. Accurate knowledge of the existing state systems must be preliminary to intensive research. We must know the present methods before attempting to recommend changes.

2. A comparative analysis of highway funds raised in states using the several methods of financing highway improvements. This information will indicate the proportionate amounts of revenue that can be raised by different systems of financing.

3. Comparative analysis of highway expenditures and the sources of highway funds in typical states to determine the share of the total highway improvement costs each contributing share produces. This information is necessary to show what part of the costs each source of revenue bears.

4. *Analysis of the share of the total highway improvement costs each contributing source of revenue should produce, based on the benefit and ability theories of taxation.*

5. Surveys of the contribution of urban and rural sources of highway revenue. Data of this type are necessary to determine whether or not it is necessary to differentiate between urban and rural taxation for the purpose of rural highway improvement.

6. Research in highway bond financing.

(a) The total highway bond indebtedness, state and county; (1) The types of issues; (2) Maturity, rates of interest and marketing factors and (3) Methods of amortization.

(b) General principles determining the necessity for the use of credit.

(c) The distribution of the cost of bonding, principal and interest, between the sources of highway revenue.

(d) The cost of different types of highway bond issues according to maturity and amortization.

7. The amount of personal property taxation of motor vehicles.

8. Analysis of the relative merits of present methods of motor vehicle taxation.

9. The relative benefit to vehicle transportation of the different types of highway improvement. This data is usable as one of the measures of motor vehicle contribution to highway improvements.

10. The average benefit to rural land per acre due to highway improvements. This will serve as a rough measure of real property taxation for rural highway improvements.

Responsibility for Protruding Pier Stub

Affirming the decisions of lower courts, the U. S. Supreme Court has decided that the Southern Pacific Co. and the California Pacific Bridge Co. are not liable for the sinking of a dredge owned by the Olympian Dredging Co. In 1895 a new bridge was constructed over the Sacramento River. Under regulations approved by the Secretary of War, the piers of the old bridge were to be cut down so as not to menace navigation. The facts show the piers were cut deeper than required, three or four feet below the bed of the river. Later, the government dredged the river to improve the channel and the pier stubs protruded above the new river bed. In 1918, a dredge struck a stub and was lost. The decision is to the effect that the defendants complied with all regulations and had no means of knowing of the change in the river bed that had taken place, and hence were not liable for damages.

Boston Asks Students' Aid in Solving City Problems

Four Prizes of $500 Each To Be Given to Boston "Tech" Students for Best Plans for Municipal Improvements

THE City of Boston through Mayor James M. Curley has offered $2,000 in four prizes of $500 each for the "best reports and working plans for solving certain municipal problems and improving the administration of certain municipal functions and activities." The competition is open to any student enrolled at the Massachusetts Institute of Technology in 1922-23 and is to be concluded May 1, 1923. The subjects covered are street traffic, street cleaning, malodorous and insanitary nuisances and fire protective building construction.

As a part of the conditions of the contest it is stipulated that a prize award carries with it full rights, with no further payments, to the use of the devices or methods proposed. One judge is to be selected by the Mayor, one by the head of the Department of Civil and Sanitary Engineering at the Institute and the third by the two so selected.

In outlining the conditions of the competition Mayor Curley gave the following explanation:

To the end that the hazards, congestions and delays of street traffic may be diminished, that the dangers to public health from polluted waterways and offensive trades and enterprises may be minimized, that dangers to life and property by fire and wreck may be decreased by improving the safeguards in building construction, and that the interests of the city's industry, commerce and retail trade may be conserved and its prosperity increased by relieving them from the handicaps imposed by the evils indicated, the City of Boston, desirous of securing a larger measure of efficiency in the administration of the municipal departments and agencies having these functions and activities in their charge and care, will pay the sum of $500 for the best report and working plan or plans submitted by a student of the Massachusetts Institute of Technology on any of the four subjects indicated in a list below.

1. *Street Traffic*—How best can the flow of vehicles be made to move more quickly and continuously, so as to avoid blockades and congestions, minimize danger to foot passengers, remove delays and difficulties, provide parking facilities and prevent undue dawdling with the least public inconvenience—without impairing the efficiency of commercial service or checking the expansion of the business of the retail trade section of Boston? Having in mind the financial limitations of the municipality, and the imperative necessity of relieving the congestion of the narrow streets of a crowded business section of meager limits—how would you proceed to secure relief and keep it? Widening streets, removing sidewalks, substituting arcades without destroying the superstructure of buildings, eliminating certain classes of vehicles, regulating deliveries and shipments by time restrictions or how?

2. *Sanitation*—How can the streets of Boston and the lanes, alleys and ways tributary to them be kept clean, sanitary and safe, at a minimum of cost and maximum of results? In working out this problem have in mind the public peace and convenience, the prompt and final disposal of waste and insanitary material collected, the question of hours when the work should be done, the character and kind of machinery and vehicles to be used, and some practical suggestions for retrieving useful and merchantable by-products to offset some of the costs of administration.

3. *Sanitation*—What is the best method controlling and regulating necessary but offensive industries and enterprises situated inside the jurisdiction of the municipality,—garbage plants, rendering establishments, oil refineries,—so that their malodorous and insanitary features may be rendered innocuous their waste be sterilized and prevented from polluting the soil and water adjacent to them and their detrimental influence on the health and values of neighboring localities be corrected or minimized?

4. *Protective Construction*—Section 32 of chapter 550 of the Acts of 1907 directs that in building construction fire protection shall consist of: (*a*) Concrete, and describes the method of protection. (*b*) Terra cotta, and describes the method of protection. (*c*) Brickwork to be set in cement mortar. (*d*) Any material or form of construction that will resist the action of flames and a heat of 1,700 deg. F. for at least two hours without raising the temperature of the material to be protected above 550 deg. F. through a thickness of 2 in. as determined by fire and water tests for fireproofing construction adopted by the American Society for Testing Materials.

The problem here for the student is to ascertain whether or not a better and more effective method of protecting steel construction from heat can be secured, a method that can be applied in a simpler and less expensive manner and which will not add to the weight the construction should carry nor to the cost of material. The nature of the material and the manner of its application should be fully described and the reasons for its superiority and desirability be clearly explained. There are many systems in the market; can the student suggest a better one and why?

Percentage of Water Pumped Which Produces Revenue

How a Water Company Raised the Revenue-Producing Percentage from 48 to 90 Per Cent of Water Pumped

By H. F. Huy
General Manager, Western New York Water Co., Buffalo, N. Y.

IN THE determination of rates for water, gas and electricity, utility commissions and courts have often raised the question, "What percentage of the commodity furnished is revenue-producing?" Several authorities have given their opinion on this subject. For water-works the percentage has been placed at from 50 to 70 per cent of the total pumped. Such opinions are based on the experience of different cities and have been accepted by various communities and corporations on the assumption that the larger plants of cities and corporations were conducted on the most economical lines and should show the best results. The average water-works man was content to know he met average conditions. Lately a prominent engineer, in testifying before a utility commission, stated that of water pumped 75 per cent should be revenue-producing or accounted for in legitimate use. Although he had heard, he testified, of an isolated case in which it was claimed that revenue was received for 90 per cent of the water pumped, he questioned the correctness of the claim. To disprove the widespread belief that only a comparatively low percentage of water supplied can be made revenue-producing the following information has been prepared:

The Western New York Water Co. operates in the suburbs of Buffalo, N. Y. The system comprises approximately 160 miles of mains of 4- to 24-in. pipe; 75 per cent of the distribution mains are 6 in. in diameter and over, the average size being near 12 in. The territory supplied has a population of 60,000 people and the service is furnished through 6,000 domestic taps and 130 industrial and commercial services. The fire protection to the communities is furnished through 648 fire hydrants. In addition to the domestic and industrial consumers, the company furnishes water at wholesale through meters at the boundary lines to three

villages that own distribution systems comprising a total of 3,000 services. The water is pumped by electrically-driven centrifugal pumps, under an average pressure of from 60 to 90 lb. The output is recorded by Venturi meters. Fifty per cent of the water pumped by the main pumping station is repumped at pressures varying from 60 to 130 lb. The plant is 100 per cent metered, including the 3,000,000 gal. a year of water supplied without charge. The record for the last four years follows:

TOTAL WATER PUMPED AND REVENUE-PRODUCING PERCENTAGES

Year	M. G. D. Pumped	Percentage of Water for Which Revenue Is Received
1918	8.5	88
1919	8.2	92
1920	9.4	90
1921	8.3	88

The plant has been in operation for about 22 years and was 100 per cent metered at its original installation. About 10 years ago, when the writer was called in consultation, the amount of revenue-producing water had dropped to 48 per cent and it was very desirable that steps be taken at once to remedy this condition.

Meters Put in Order—Some of the large commercial meters of an obsolete type were replaced or repaired. Upon test it was found that some of them did not register on normal low flows and only about 60 per cent of the quantity of water passed at or above the average-flow rates.

The domestic meters, many of which were out of order or under-registering, were also overhauled. After the larger meters were repaired and many of the smaller meters were repaired or replaced, the percentage of revenue-producing water was increased to 73 per cent.

Inspection—A careful pitometer survey of the distribution system of the company was made. At the same time commercial meter readings were taken and allowance made for domestic consumption in each survey district. In this manner leakage and losses in the various districts were determined. Inspections were also made of the pipe lines for possible leaks showing on the surface. The microphone was applied to the various valves and hydrants. In sections where mains were located under paved streets and there was no nearby listening connection, the microphone was employed directly over the water main which was determined by the wireless pipe-locating device. A leak on the main has been located within a foot of the actual leak through 5 or 6 ft. of earth. Mains, 4 and 6 in. in diameter, resting on rock have been broken by the vibrations set up by large trucks. By this inspection the revenue-producing water was increased to 78 per cent of the water pumped.

Mains and Services—While the pitometer survey showed the general location of the unaccounted-for water lost, it was so evenly and widely distributed in the territory supplied that the exact location of the various points of leakage could not be readily observed. A careful house-to-house inspection of services was then carried on by listening on all the service pipes for leaks. A large amount of the unaccounted-for water was traced to leaky service pipes, especially under brick and asphalt pavements or where service pipes and sewer pipes had been laid in the same trench and the settlement of the sewer had broken the water pipe, the water finding its way into the sewer system. A careful check was kept on the flow past various sewer manholes in an endeavor to locate leaks.

A considerable portion of the piping system had been installed in the communities before they became thickly populated, and no careful record had been kept of the location of the pipes. Often other utility company structures interfered with the accessibility of the water mains. A large leak under a telephone manhole was finding its way into the conduit-manhole drain.

After completion of the house-to-house inspection, and making the necessary repairs, the revenue-producing water was increased to the percentage shown in the table, varying from 88 to 92 per cent in the last four years. While the years 1920 and 1921 show a decrease of 2 per cent each in the accounted-for water, the total quantity of unaccounted-for water is very near the same.

Allowable Leakage—The leakage on a well maintained distribution system should not exceed 3 per cent of the total quantity pumped. One per cent should cover the amount required for fire purposes. This estimate is based on fire records in the communities supplied—length, time and number of fire streams used. The allowable under-registration of meters on a well maintained metered system, should not exceed 5 or 6 per cent. It is therefore the writer's judgment that on a carefully operated and inspected 100 per cent metered system, 90 per cent of the water pumped should be revenue-producing, providing there is no free water furnished for municipal or other purposes.

Precautions—Too often no attention is paid to the service connections to the mains; the plumber is allowed to purchase the material and install it. The only time the water company's representative is on the work is to make the tap at the main. Many leaks on service lines occur at wipe joints and it is now the practice of this company to allow no wipe-joint connections to be used; lead-flanged union connections only are permitted. Service lines are often not laid the proper depth and are frozen. The service pipe is often laid in the sewer trench or on a supposed shelf alongside the sewer. This should not be permitted. It has been found advantageous to have the water pipe at least 5 or 6 ft. from any sewer lateral connections. Too much importance cannot be laid on water-works employees either installing the service connections themselves or having careful supervision over plumbers making the installation.

Unmetered fire connections were found to be a distinct loss of revenue, as many of these connections lead to large plants which have extensive lines over which the water company has no careful supervision. In every instance in testing an unmetered fire connection, an indication of water being used or wasted was observed. After the company installed meters on these fire lines, it received revenue from the water passing through the meters.

The meters of all industrial and corporate consumers are read monthly and of domestic users every three months. This enables the water company to check its revenue-producing water each month. Any drop-off is immediately noticed and steps taken to learn the reason.

The results outlined above should be obtainable in any carefully operated water-works plant, as they are due to carefulness, patience and perseverance in looking after the leaks and in maintaining the meters in good registering condition.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Colloidal Clay, Color and Turbidity in Water

Sir—In *Engineering News-Record* of Oct. 12, p. 625, F. B. Marsh "hazards the guess that colloidal clay neutralizes the color and that something connected with the color neutralizes the clay and thus both the turbidity and the color (of the water) are eliminated."

That this "guess" is substantiated by theoretical and experimental facts is clearly shown by a consideration of the turbidity (chiefly clay) and the coloring matter (chiefly humus or humic acids) as colloids. T. Hardy (1899) has shown that colloid particles, which always carry electric charges, will coagulate and precipitate when they are made electro-neutral, at the so called "iso-electric" state. This would point to an immediate general solution of the problem were it not for the fact that the same colloidal substance may appear either as positive or negative, depending upon the condition of the dispersion medium. In other words, we cannot expect the same results with acid and basic waters.

It is, however, highly possibly that clay, usually electro-negative or acid, and humus, always electro-positive or coagulated by acids, do mutually precipitate each other, since adsorption compounds are formed after the electric charges are neutralized. Nature uses a similar method to precipitate the clay at the mouth of rivers and form deltas, the neutralizing and precipitating agent being salt. There is no doubt that a careful analysis of the constituents in the turbidity and in the coloring matter will point to the proper chemicals for complete precipitation. It must be remembered that such a method for water purification will remove the inorganic materials only (although coagulating colloids will encase and carry down large amounts of organisms); that careful and skilled supervision will be required to allow for changing conditions; and that each case must be studied separately. JACOB FELD.

Brooklyn, N. Y., Oct. 23.

Packing New Joint for Gas Main

Sir—In regard to my article on "Methods and Cost of Laying Gas Main with New Joint" in *Engineering News-Record* of Oct. 5, p. 572, a number of men have asked me what was the thickness of the three strands of yarn which were placed in the back of the bell. In order to get the maximum strength from the "B" bell it is important to use as little yarn as possible. The face of the yarn must be back of the foot of the inclined plane or apex of cone which forms the bead of the spigot. Unless this is done the additional strength of the joint, due to shear, will be lost as the bead will bear against the comparatively soft cushion of the yarn instead of the cement.

St. Louis, Mo. JACOB D. VON MAUR,
Nov. 10, 1922. Supt. of Distribution, Laclede Gas Co.

A Warning to Contractors

Sir—It might be well to call contractors' attention to the fact that before starting work they should see that the bonds that were issued for the work were sold and the money available for the work to be done.

The last session of the Maryland Legislature passed bills permitting different counties of the state to issue bonds for improvements such as schools, bridges, etc. Washington County issued $300,000 worth of school building bonds, advertised and sold and got the first payment from purchasers of bonds. After the first payment was made the purchasers discovered that the legislative vote had not been counted at time of passage of bill and thereby the issue was invalid. The County Commissioners sued the bankers for the deferred payments and the courts decided in favor of the bankers.

The board of education awarded contracts for two schoolhouses in the county and work was about half done when the board of education found it had no money to pay the contractors for work done. For the contractors to stop meant a loss and to go ahead meant doubt as to when they would get pay for their work.

The county commissioners came to the rescue of the board of education by some means of adding to the next tax collections enough to pay the contractors for work done. The school building program is held up till the next session of legislature can vote on the bond issue.

A contractor may get stung if he starts work for which the bond issue has not been passed on and found legal in every detail. THOMAS SHEAHAN.

Hagerstown, Md., Nov. 3.

A Dam Is as High as It Dams

Sir—Replying to your query, "How High Is a Dam," discussed editorially in your issue of Nov. 2, p. 728, my answer would be: a dam is as high as it *is* a dam. That is to say, its height is so much of its vertical dimension as is physically effective to restrain the flow of a fluid. Hence the standard of comparison for height of dams might be considered the unbalanced head against the structure—the difference in water level between low water in the stream bed and high water in the pond—the vertical offset in the hydraulic gradient occasioned by the dam.

Since there is tail water or ground water in the stream bed at the toe of practically all dams, the point of departure for height measurement would commonly be the natural stream bed, or low-water mark, and the upper objective would be the top of parapet on the dam wherever that is a solid wall integral with the main structure; otherwise the crest of the dam proper where the parapet is an open balustrade. You are certainly right in claiming the solid parapet of Arrowrock Dam as part of the effective height.

You are most emphatically right in stating: "Difficulty of construction legitimately calls for overall heights, etc." Difficulty, cost, and general grief of dam building should be reckoned to increase as the square of the depth below stream bed, and plotted on a fashionably logarithmic scale. Anybody who has fought his way foot by foot of excavation down to the bitter bottom in bedrock of a pit 100 ft. below river level, and up again inch by inch of masonry, against a time limit between floods, must have realized that the veritably controlling factor in the whole dam business is depth below stream bed, rather than the most ambitious skyward penetration. Therefore your conclusion is utterly sound, that the constructor should be given credit for overall height.

My conclusion then is that no single word or figure can tell the height of a dam relative to all other dams, but you must set up a double standard of comparison, suggesting: (1) Extreme Height; (2) Effective Height. Extreme height would be the difference in elevation between the lowest and highest points of the structure. Extreme effective height would be the difference of elevation between low water at toe and high water at crest of dam—noting that this difference would be subject to unimportant variations according to whether the dam were an overfall structure or whether a separate spillway would hold all floods below the crest of the main dam. In the case of overflow dams the additional head in the pond would be approximately balanced by increased height of tail water, so that the net hydrostatic head would not be widely variable for full reservoir conditions.

According to these definitions you are right in answering Mr. Wegmann that Arrowrock Dam, as yet, overtops them all in extreme height. But the Don Pedro Dam, now nearing completion, in Tuolumne River, California, has set a new superlative with its effective height of approximately 280 ft. above stream bed.

Among all dams of high degree, now built, building, or proposed, the Shoshone remains unique in that its height

is its greatest dimension; and this is true whether its extreme height of 328 ft. or effective height of about 240 ft. is considered, since the extreme length at top is only 200 feet.

San Francisco, Calif. D. W. COLE.
Formerly Engineer in U. S. Reclamation Service in charge of Shoshone and Lahontan Dams

Montana's Highway Policies

Sir—Unless we are very careful we will fall into the habit of thinking that the completion of the so-called 7 per cent system of federal-aid highway projects through the country will solve the road problem. I am inclined decidedly to a contrary opinion. In Montana today we are convinced that any highway program or policy suggested by the department must recognize the local importance of roads not on the trunk-highway system. We believe too that present knowledge of highway construction, highway economics and the trend of traffic does not justify the assumption that the road problem can be solved for all time by any single effort.

For several years I have felt that the public would react against the enormous expenditures that have been made for expensive highway improvements, particularly when the cost of such highways was dictated by the necessity for serving truck traffic. To a certain extent I believe this reaction is already apparent in several states in the West.

In view of the public demand for retrenchment and for a reduction of expenditures—and this demand seems to disregard the ultimate economy of or profit from the expenditure—it is comfortable for us here in Montana to remember that we have not been stampeded into any costly paving program, but have confined our efforts to the building of a large mileage of serviceable gravel highways. This policy has been maintained in the face of ridicule and the suggestion that we were decidedly behind the times. About the only change that I can anticipate in the prosecution of the state's road program is one which will permit the state to go forward more rapidly toward the development of the state and county road systems.

One of the fundamental principles underlying the management of public works departments is this: You can not spend money any faster than the public will provide it nor for any purpose which the public does not approve. It is not at all significant that the public's conclusions may be erroneous and non-supportable by economic arguments. In my opinion we have not exhausted the possibilities of educating the public to the need for and the cost of improved highways. JOHN N. EDY,

Chief Engineer, State Highway Commission.
Helena, Mont., Nov. 14.

Mineral-Oil Paint for Galvanized Sheets

Sir—In your Nov. 2 issue F. H. Thomson, of Kilmarnock, Scotland, brought up the question of painting galvanized sheets. It happens that I recently had occasion to investigate this subject and I encountered a surprising lack of authoritative information and a diversity of views. The consensus of opinion seems to be that paint will not adhere to fresh galvanizing on account of the oily film. The methods suggested for removing this film range from the simple but time-consuming expedient of several months' exposure to various complicated formulas for "washing" it off. All of these methods result in a destructive, or more properly a corrosive, action on the zinc.

While in theory galvanizing is a protection against ordinary corrosive action of the elements, in reality the present-day product is not of a quality to withstand several months' exposure to weather without serious effect on the zinc, especially if subjected to the action of salt air. The copper-acid combinations mentioned by Mr. Thomson are perhaps efficient as oil removers, but coming in contact with the zinc they produce an electro-chemical action in which the zinc is decidedly the sufferer. Inasmuch as the zinc is applied as a protection, obviously anything which tends to destroy it is objectionable. The logical solution is a paint which will adhere to fresh galvanizing without the necessity of any previous treatment of the surface.

Investigation developed the fact that the usual linseed or other vegetable oil paints will not adhere to fresh galvanizing because the mineral oil composing the film on the zinc mixes with the vegetable oil in the paint and prevents, or at least greatly retards, the hardening of the latter. Mineral oil does not oxidize like the linseed oil, and when added to linseed oil paint makes it permanently sticky and incapable of hardening to a firm film. The surface may appear hard, but underneath the paint remains soft and sticky and therefore does not adhere firmly to the metal.

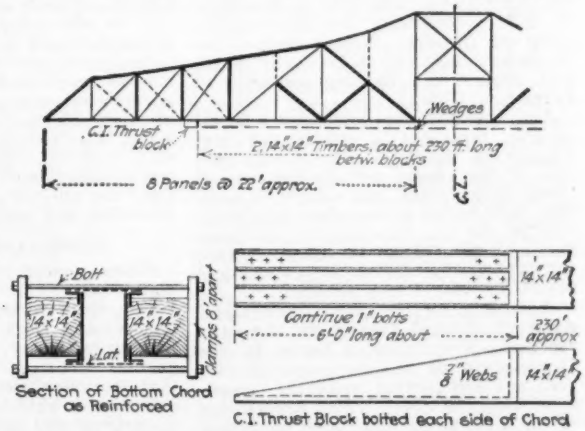
On the other hand a properly mixed paint of the proper mineral oil constituents will absorb the mineral oil on the galvanized surface without in any way impairing the efficiency of the paint, or retarding its setting and drying properties. As the mineral oil paint has moisture and acid-resisting properties superior to those of the vegetable oil paints, and yields an extremely tough film, there need be no hesitation in using it instead of the linseed oil paints or the commercial substitutes now so generally used.

Strangely, this is not a new development, but a paint of this kind has been used for years on galvanized roofs and other exposed galvanized surfaces with entire success. I have seen it applied to fresh galvanizing with perfect results as to adhesion and effective covering.

HARRY CARLTON.
Harry Carlton & Associates, Sales Engineers.
New York, Nov. 24.

Doubtful Bridge Reinforcement

Sir—The accompanying sketches show a method of alleged strengthening of the trusses of a swing bridge in Oregon. This bridge was originally designed, in 1904, for a plank roadway about 32 ft. in clear width, including two street-car tracks. In 1921 the span was paved with asphalt while the draw was over its rest during other



BOTTOM-CHORD REINFORCEMENT OF PIN-CONNECTED SWING SPAN

repairs, but upon swinging the draw the extra load of the asphalt was discovered to have depressed the free ends about 7 in. below the approaches, requiring slight inclines to match the ends. While a new draw rest was being built this year, the contractor "discovered" that the bottom chords were "buckled" and secured an emergency contract for strengthening them as per the sketches herewith, the work being under the charge of two county officials licensed under the Oregon law to practice engineering.

Aside from the impossibility of wood and steel acting in unison under changes in temperature, the alleged reinforcement actually weakens the bridge by about 15 per cent in the service position with bottom chord in tension, due to the boltholes.

This weakening, together with the excess dead load of asphalt paving, reduces the live-load capacity of the bridge by about 40 per cent. Even before the paving was laid, this bridge was alleged to be unsafe for its traffic. Such is one example of the workings of an ill-advised license law. GEORGE RAE.

Portland, Ore., Oct. 21.

NEWS OF THE WEEK

New York, November 30, 1922

Army Camp Builders Sued for $21,500,000

Government Would Recover From Thompson-Starrett, Fuller, Bentley, and Hardaway Companies—Other Suits Imminent

Suits to recover $21,500,000 alleged to have been fraudulently obtained in the construction of cantonments during the World War were begun Nov. 24 at the direction of Attorney-General Daugherty. Though information is given that other suits may follow, whether suits will be instituted against contractors who erected other army cantonments remains a matter for conjecture. Twelve other cantonments were built comparable in size to the four involved in the suit described herein. The firms, the cantonments involved in the suits, and the amounts the government would recover in each case are: Thompson-Starrett Co., Camp Upton, (Yaphank, Long Island), $6,000,000; George A. Fuller Co., Camp Funston (Fort Riley, Kansas), $4,000,000; Hardaway Contracting Co., Camp Jackson (Columbia, S. C.), $6,500,000; and A. Bentley & Sons Co., Camp Sherman (Chillicothe, Ohio), $5,000,000. The suit against Thompson-Starrett Co. was filed in Brooklyn, N. Y.; that against the Fuller company at Topeka, Kan.; against the Hardaway company at Columbia, S. C., and against the Bentley company at Columbus, Ohio.

The amounts the government would recover represent a substantial percentage of the total cost of construction of the camps, and in the case of Camp Jackson the sum sought is more than half. The government paid $12,710,720 for the construction of Camp Jackson; $15,370,820 for Camp Upton; $13,247,620 for Camp Sherman, and $11,715,520 for Camp Funston.

According to the announcement of Attorney-General Daugherty the suits represent investigations begun by the Department of Justice more than a year ago and carried on by the department until the Special War Branch was organized and by that body with certain aid from the department until the present time.

Fraud, inefficiency, waste and gross negligence are alleged in the general complaint to have resulted not only in a loss of large sums of money by the government but in the embarrassment of its war program. The department made public a copy of the complaint in the case against A. Bentley & Sons Co. and announced that that complaint was similar to those filed against the other defendant construction companies.

The Bentley complaint alleges that the "defendant misrepresented to plaintiff that defendant had experience in the execution of similar work and an organization suitable for the performance of such work." It is further alleged that the defendant company "did knowingly, illegally and fraudulently violate and abuse such confidence and trust and breach said contract in that it did not complete its said undertaking in accordance with its terms and true tenor and spirit, and that the plaintiff was compelled to let additional contracts to others at added cost and expense to the plaintiff for the completion of such contract."

It is also alleged that the Bentley company (and presumably the other defendants) sold to and in some instances purchased and resold to the government at a profit large quantities of material and equipment, some of which was needed and some unnecessary, and that their "illegal and unwarranted claims" and vouchers in payment for alleged useless material were presented and paid by the plaintiff.

Miscellaneous Charges

Other points in the general complaint are: (1) That defendants allowed large amounts of useless and unnecessary work to be done by employing so many workmen that congestion occurred, delaying work; (2) that workmen were employed without reference to skill or experience, thereby disturbing the morale of the entire construction force; (3) that unskilled workmen were paid the same wages as skilled mechanics and in the majority of cases wages were paid in excess of the then current scale; (4) that adequate inspection and supervision of workmen were lacking, conditions which resulted in a great loss of efficiency; (5) that payment was obtained for superintendents and others acting in supervisory capacities at exorbitant rates and for time in excess of that during which they were engaged; (6) that motor trucks were often rated in excess of capacity so that the company might collect the added allowance.

In ending its complaint the government made the charge that all the foregoing was done with the "knowledge and connivance of the defendant company," causing excessive cost to the government and securing for the defendant the maximum rather than a reasonable compensation.

Application to Build Mexico-New Mexico Road Filed with I.C.C.

The customary applications in connection with proposals to build a new line of railroad have been made to the Interstate Commerce Commission by the Colorado, Columbus and Mexican R.R. Co. The proposed line is to extend from Columbus on the Mexican border, 65 miles west of El Paso, through Deming to Farmington, N. M., where it will connect with the Denver and Rio Grande R.R. The proposed line would be 550 miles long. John Philips of Wichita Falls, Texas, is the financial agent of the enterprise. George Estes is president and general manager of the company, with offices at Deming.

Civil Service Problems a Topic at Municipal League Meeting

Civil service problems and progress were the subjects of an entire session of the annual convention of the National Municipal League held at Philadelphia, Nov. 22-24. A wide range of other subjects was considered in the fields of local, state and national government. Col. Henry M. Waite, of New York City, formerly city manager of Dayton, Ohio, and before that city engineer of Cincinnati, was re-elected as president. Among the members of the council elected at the meeting was M. N. Baker, associate editor, *Engineering News-Record*. The permanent secretary of the organization is H. W. Dodds, 261 Broadway, New York City.

The civil service problems already mentioned were discussed under the general title, "New Standards of Public Employment." A committee with the same name submitted a report in which "centralized employment supervision and control in the public service" was recommended, and it was proposed that the administration of municipal civil service should be intrusted to a single commissioner and an examining board. Morris L. Cooke, formerly director of public works of Philadelphia, said that he could not conceive of efficient municipal government without civil service. Positions of importance, he said, are not readily filled except by detaching men already at work. He declared that there are not two or three or four or five best men for an important position, but only one.

In the course of a lengthy and detailed paper, entitled "Progress and Selective Tests and Public Employment," Dr. L. B. O'Rourke, in charge of psychological tests, U. S. Civil Service Commission, stated that large organizations are changing to quantitative tests of candidates instead of leaving the selection of employees to foremen as was done formerly. The tests show that slow workers are much less accurate than rapid workers.

To Electrify 30-Mile Section of Vera Cruz-Mexico Railway

Contract for the electrification of 30 miles of track on the Mexican Ry. Co. Ltd., between Orizaba and Esperanza on the main line from Mexico City to Vera Cruz has been announced by the International General Electric Co. The project calls for the expenditure of between $2,000,000 and $2,500,000 and will be financed through London.

The system will be operated by 3,000-volt direct current which will be supplied by the Pueblo Tramway, Light and Power Co. from its hydro-electric plant about five miles from Orizaba. The present contract includes ten 150-ton locomotives, equipment for one substation, overhead conductors and accessories. The ruling grade on the electrified section will be about 4.7 per cent.

Second Hearing Is Held on Carquinez Straits Bridge

Proposal to Cross San Francisco Bay With High-Level Bridge Again Heard by Army Engineers

A hearing was held in San Francisco on Nov. 14 before Col. Herbert Deakyne, Engineers Corps, U. S. A., on the application of the Rodeo-Vallejo Ferry Co. for approval of a plan to construct a high-level suspension bridge for highway traffic across Carquinez Straits from Valona to Morrow Cove. This site is a short distance downstream or west of that selected by the San Francisco Transit Co. whose application for a permit was reported in *Engineering News-Record*, Sept. 28, p. 537.

The Rodeo-Vallejo Ferry Co. which now operates automobile and passenger ferry boats across the straits has recently secured an amendment to its charter giving it the right to build and operate bridges. Charles Derleth, Jr., engineer for the company, presented preliminary plans for the proposed structure and described it as a three-span suspension bridge with a 1,600-ft. main span, two 800-ft. supporting spans and a clearance of 135 ft. above high water. The estimated cost is $4,000,000.

Plan Opposed

Opposition to the plan was offered by navigation interests and owners of wharves above the proposed location. The California-Hawaiian Sugar Co. claims that the south pier would make navigation dangerous in the swift tidal currents through the straits and would discourage deep sea traffic to wharves beyond the bridge.

In opposition to this it was shown that the ferry traffic across the straits in four years had increased from 300,000 to 1,000,000 passengers per year and from 100,000 to 400,000 automobiles per year. At this rate it was claimed the number of ferry boats soon required would create a navigation menace exceeding that offered by the bridge piers. Admiral J. S. McKean, commandant of Mare Island Navy Yard, spoke in favor of a bridge and rated increased ferry service as a greater menace than that offered by the bridge. Several presentations were made requesting that only one permit be granted for constructing a bridge across Carquinez Straits.

Representations were received at this hearing on five bridge projects other than that of the Rodeo-Vallejo Ferry Co. Three of these crossings, proposed by Captain John G. Little are, respectively, from Oleum to Vallejo, from Martinez to Benicia, and from Antioch to Sherman Island. The two other appearances were entered by the San Francisco Transit Co. and by the Dillon Point Development Co. for a high-level bridge at Dillon Point within a mile of the San Francisco Transit Company's site. The Dillon Point structure would also be a three-span suspension bridge for highway traffic and would have a 1,750-ft. main span with supporting spans of unequal length, one being 450 ft. long and the other 750 ft. long. The estimated cost is $2,700,000.

In accordance with the usual custom, Col. Deakyne's report on the hearing is to be transmitted to the Chief of Engineers, U. S. A., at Washington.

The Engineer in Public Life

CHARLES HANSEL

For four years the Civic Board of Cranford, N. J., has had an engineer, Charles Hansel, as its president. The board's main object has been to create sentiment in favor of a county park system and has resulted in the organization of the Union County Park Association, of which Mr. Hansel is vice-president. This work bore fruit in the form of the establishment of a permanent county park commission, with authority to expend a sum not exceeding $2,500,000. Mr. Hansel was the guest of honor at a dinner given last spring by the Civic Board of Cranford in recognition of his public service in connection with the park movement.

He is a consulting engineer, with offices in New York City, and has been prominent for many years in the field of railway valuation. Mr. Hansel was chief engineer of the Wabash Railway from 1884 to 1899, and later made appraisals for the States of Illinois, Michigan and New Jersey of railroads and canals. He has also served as consulting valuation engineer for the Pennsylvania, the Philadelphia & Reading, and Jersey Central railways.

Court to Rule on Powers of Cleveland Terminals Co.

Argument as to the right of the Cleveland Union Terminals Co. to appropriate property for the proposed Cleveland Union Station was begun on Nov. 27. The controversy hinges on the alleged intention of the Terminals Co. to sublet the air rights over the railroad facilities to the Terminals Building Co. for commercial development.

The Terminals Co. is backed by the New York Central, the Big Four and the Nickel Plate railroads through whom was obtained the authority of the Interstate Commerce Commission to issue $60,000,000 in bonds to finance the terminal. The Terminals Building Co. is said to be controlled by the Van Sweringen interests which initiated the station project and later interested the railroads in it.

Owners whose property the Terminals Co. seeks to appropriate contend that under the circumstances the right of eminent domain cannot be invoked. The testimony offered during the hearing by the Terminals Co. has aimed to prove that it has made no plans for the construction of offices or stores over the station and that all of the property sought is needed for strictly terminal purposes. Against this the property owners point to pictures used to promote the enterprise in 1919, to evidence offered to the Interstate Commerce Commission as to prospective revenues from commercial rentals and to the contract between the railroads and the Terminals Co., all of which, they assert, substantiates their contention.

Cement Association Reviews Twenty Years' Work

Announcement of New Technical Activities Made at Annual Meeting

On Tuesday and Wednesday of last week the Portland Cement Association held in Chicago its twentieth anniversary meeting. Outstanding in interest were the announcements that the association's laboratory was beginning a study of the constitution of portland cement and that the facilities of the laboratory were to be increased by the addition of a 2,000,000-lb. testing machine. Reports of the board of directors and of the president disclosed a satisfactory year in the industry, with total shipments for 1922 estimated at 110,000,000 bbl., or 12 per cent above the country's previous high record. The attendance was the largest in the association's history—302 individuals, representing 72 of 86 member companies.

The address of the retiring president, L. T. Sunderland, of the Ash Grove Lime & Portland Cement Co., Kansas City, laid stress on the opportunities ahead, contending that there is not only much need for broader and more persistent educational work but for additional research into the uses and character of the product. He declared that the association's newspaper advertising has been effective in informing the public regarding the industry.

Committees Report

The Committee on Technical Problems, besides announcing the research into the constitution of portland cement (which will be carried on by Dr. J. C. Witt), placed stress on the importance of a comprehensive study now being made of the action of alkali on concrete. Field tests under a wide variety of conditions and with many mixes, as well as laboratory studies, are under way. The laboratory staff, now numbering 35, was strengthened this fall by the addition of H. F. Gonnerman. Gratification was expressed at the widespread acceptance and use of the proportioning tables based on the Abram's cement-water theory.

The Committee on Conservation listed a number of studies under way looking to economy in production.

A history of the portland cement industry, written by Robert W. Lesley and John B. Lober, past-presidents, was announced as having been completed.

F. W. Kelley, of Albany, N. Y., president of the Helderberg Cement Co., was elected president of the association for 1923. With him will serve as vice-presidents, Blaine S. Smith (Universal) and L. R. Burch (Atlas), as treasurer, Col. E. M. Young (Lehigh), and as newly-elected directors, Carl Leonardt (Southwestern), W. D. Lober (Vulcanite), L. T. Sunderland (Ash Grove), C. B. Condon (Hawkeye), F. H. Smith (Lawrence) and Loring A. Cover (Security).

A gala banquet in honor of the close of the first twenty years of the association's life terminated the meeting. John R. Morron, president of the Atlas Portland Cement Co., New York, and Rev. David J. Evans, Th.D., of Kansas City, were the speakers. Mr. Morron paid high tribute to those who had successfully led the association in the past, and recalled that at the association's inception, in 1902, the industry's an-

(Continued on p. 951)

Power Commission Makes Second Report

Construction on Projects Totaling Nearly Million Horsepower Under Way—More Licenses Issued

Progress under the federal water-power act is detailed in the second annual report of the Federal Power Commission covering the period up to July 1, 1922. Due to the many years' delay in securing adequate federal legislation it was but natural that a flood of applications should have followed immediately upon approval of the act. Nevertheless, during its second year there have been filed with the commission applications aggregating a net total of 5,000,000 hp. of proposed installation. This amount, added to the applications of the preceding fiscal year, makes a grand total of 357, involving in excess of 21,100,000 horsepower. Nearly one-half of the aggregate is represented by applications upon the St. Lawrence, Columbia, and Colorado Rivers, upon which, in general, action has been suspended. The St. Lawrence involves international relations and may require a treaty before action can be taken. The Columbia has been under investigation by a special board to determine, before applications are approved, the relation between water power, irrigation, and navigation upon that stream. Action on the Colorado River is awaiting the findings of the Colorado River Commission. There has been criticism in certain quarters that the definition of navigable waters as contained in the Act is not sufficiently clear, and that the Act should be so modified or the definition so interpreted by the commission that the limit of navigability on any stream may be determined with such exactness that no one need ever apply to the commission for its determination.

"The question of navigability," says the report, "is not one of mathematical formulas, and there is no more probability that it can be removed from the domain of individual judgment than that our laws in general can be drawn with such precision that the services of the courts in their interpretation can be dispensed with. The decisions of the commission in the individual cases presented to it will establish precedents which will gradually clear the situation. Three recent cases on interstate streams, the Saco River, running from New Hampshire into Maine, the Connecticut, a boundary between New Hampshire and Vermont, and the Menominee, a boundary between Wisconsin and Michigan, are indicative of the policy the commission is pursuing. The first two are actually carrying property in interstate commerce in considerable quantities in the form of logs and pulp wood, and the third is suitable for such use. All three are, therefore, technically navigable; but due to the fact that in each instance the laws of the state afford full protection to such commerce, and that the proposed dams would not obstruct it, the commission made formal finding that the streams were not 'navigable waters' within the definition of the Act, that the proposed dams would not affect the interests of interstate commerce, and that, therefore, no federal license was required for their construction. The commission does not propose to extend its jurisdiction in this respect beyond the point where some substantial interest of interstate or foreign commerce is involved."

Of the power projects authorized up to June 30, 1922, work has been started and in some cases completed on 27, with a total power capacity of 853,448. Of these the table herein details the data on those having a power capacity of over 5,000 hp.

POWER PROJECTS STARTED UNDER WATER POWER ACT

License No.	Owner	River	Power Capacity Hp.	Installed Hp.
16	Niagara Falls Power Co.	Niagara River, N. Y.	341,505	572,230
20	Utah Power & Light Co.		5,120	21,000
67	South. Calif. Edison Co.	Big Creek, Calif.	158,000	545,000
78	Western States Gas & Elec. Co.	American River, Calif.	6,400	8,100
82	Alabama Power Co.	Coosa River, Ala.	21,700	100,000
96	San Joaquin Light & Power Corp.	San Joaquin River, Calif.	10,250	45,000
108	Wisc.-Minn. Light & Power Co.	Chippewa River, Wis.	10,043	20,000
120	So. Calif. Edison Co.	San Joaquin River, Calif.	55,000	195,000
135	Portland Ry., Light & Power Co.	Clackamas River, Ore.	25,300	30,000
175	San Joaquin Light & Power Corp.	Kings River, Calif.	161,000	266,000
184	El Dorado Power Co.	American River, Calif.	30,000	100,000

I.C.C. Denies Advance Access to Valuation Field Notes

The Interstate Commerce Commission has denied to the Chicago, Rock Island & Pacific R.R. and the St. Louis-Southwestern R.R. advance access to the field notes taken by its employees on valuation work, until a formal hearing either before it or before a court of competent jurisdiction. These roads sought copies of the notes on accounting, engineering and land appraisal.

The commission held that it would not be in the public interest to reveal to any railroad in advance of the hearings the data upon which its tentative valuations have been based. Such a course, it asserts, would unduly prolong the valuation and make it difficult to obtain uninfluenced expert opinion. The railroads contend that they should know before the hearings the identity of the experts whose views have contributed toward the establishment of the tentative valuations, which have been determined without consulting the roads.

I.C.C. Resumes Investigation of Railroad Brake Equipment

The Interstate Commerce Commission on Nov. 8 resumed its investigation of air-brake systems, begun last May. This is the second session on the subject. One or two other hearings will be held later and the investigation probably will be concluded in January. The first days of the November session were devoted to direct and cross-examination of representatives of the Automatic Straight Air-Brake Co., who placed forty-eight exhibits before Examiners Mullen and Borland.

All corporations producing and marketing power-brake systems for railroad rolling-stock will be heard before the examination is concluded, as well as representatives of users.

Heavy Power Demands Are Made on Niagara System

It is officially announced that owing to the rapid increase in the power load of the Niagara system the Ontario Hydro-Electric Power Commission has notified consumers that their present demands must not be exceeded until the fourth generator of the Queenston plant has been installed. The amount of power generated and purchased by the commission is now in excess of 525,000 hp., of which approximately 183,000 hp. is being supplied by the three Queenston generator units.

The work of completing the installation of the fourth unit is being pushed with all speed and it is expected it will be ready for service about Dec. 1. The commission hopes to have sufficient power with which to meet all requirements of the system during the peak-load period of the winter months.

Gregory Commission Reports on Ontario Hydro Activities

The Hydro-Electric Inquiry Commission, locally known as the Gregory Commission, has issued an interim report covering its investigations into the Nipigon power project of the Hydro-Electric Power Commission of Ontario, Canada. The Gregory commission was appointed by the lieutenant-governor of the province to inquire into all power developments undertaken by the Ontario commission, general matters of expenditure and administration.

The report just issued deals with the history of the Nipigon venture and reports that the Hydro-Electric Power Commission of Ontario omitted to publish an estimate of the maximum price at which power would be supplied, and of the probable cost of the development. The original project, the report continues, was for a $3,000,000 development at Dog Lake. After the by-laws had been passed, however, the Hydro-Electric Power Commission of Ontario changed its plans, entering into a $12,000,000 enterprise at Cameron Falls on the Nipigon River.

The original rights on the Cameron River were held by the Great Lakes Pulp & Paper Co. and the chairman of the Hydro-Electric Power Commission, anxious to secure those rights for the commission, negotiated a deal with the Great Lakes company obligating the commission to supply the company with power. However, it failed to bind the company to take power when it was available, a failure which has been a severe blow to the commission's revenue. As a result of these losses and others, the present deficit, according to the Gregory Commission, is $340,000 a year and is likely to be three-quarters of a million annually before the tide turns.

State Buys Havre de Grace Bridge

On Nov. 22 the Susquehanna River bridge between Havre de Grace and Perryville, Md., was bought by the State of Maryland for $585,000. The structure was formerly used by the Pennsylvania R.R., and was sold by it to private parties some years ago when the railroad built a new bridge. Since then it has been operated as a toll highway bridge, and with the growth of automobile traffic it is said to have returned large earnings.

Cement Association Reviews

(*Continued from p. 949*)

nual production was only 17,000,000 bbl. whereas this year it will be in the neighborhood of 110,000,000. As for the future, he suggested that the industry should have a man who would stand to it as Will Hays does to the motion-picture industry and Judge Landis to baseball.

An index to the industry's contribution to the public, he said, was furnished by data showing that "a bushel of wheat, a bushel of corn, a ton of hay, a pound of butter, a barrel of flour, a tierce of lard, a side of bacon, a barrel of salt, a pound of sugar, a bushel of potatoes, a bale of cotton, a ton of coal, a ton of steel rails, a thousand bricks, or the wages of a laboring man, in July, 1922, would purchase from 30 to 250 per cent more cement at the plants, than in 1892.

Mr. Morron also showed that bituminous coal delivered at his company's largest plant during three months of 1922 cost more per ton than was received for the manufactured product in which the coal was used.

Industry's Importance

"The cement industry," continued Mr. Morron, "handled millions of tons of stone, inert and useless, blasted from field and hillside; guided through scores of intricate processes, and converted at last into impalpable powder shipped to every nook and corner of our land. As if by the magician's wand, transformed again to stone,

"to make safe and sanitary the isolated home of the farmer;

"to house the product of his field in silo and in elevator;

"to span alike stream and river and chasm;

"to revitalize the value of town property in making possible the massive and towering architecture of our cities;

"to build the tunnels and subways through which the weary worker speeds in comfort and in safety to his country home;

"to girdle the hemisphere with permanent roads as smooth and hard as the floors of palaces;

"to cut in two the maritime distance from coast to coast and to make possible the union of our Atlantic and Pacific oceans;

"yes, and to build the very foundation upon which rests our Goddess of Liberty who beckons and guides the oppressed of other nations to our shore.

"Broadcast and advertise these facts, and the government will join with the public, not in criticism but in marveling at what one industry has added to the progress of the generation without undue profit and without undue gain."

Dr. Evans, in a discussion of industrial progress, called attention to the tendency of leaders of industry to take leadership, as well, in matters of social progress. Only by industry itself righting its wrongs—of low wages, excessive hours, unhealthful working conditions, etc.—could it hope to ward off the interfering hand of government. Co-operation in industry had accomplished much, as the work of the Portland Cement Association showed. but he believed that a further step was desirable, in a "roundtable of industry," at which the leaders of many industries could come together for the solution of the broader industrial problems.

New President of Portland Cement Association

F. W. Kelley, president of the Helderberg Cement Co., Albany, N. Y., was elected president of the Portland Cement Association at its annual meeting in Chicago last week. He comes to the highest office in the organization after many years of service as its treasurer and as chairman of its Committee on Technical Problems. An engineer by education (Cornell, M. E., '93) Mr. Kelley's first work was in the experimental department of the Consolidated Car Heating Co., of Albany, of which, by gradual promotion, he soon became general manager. His connection with the cement industry began in 1900 when he was made vice-president and general manager of the Helderberg company, just then in the process of changing its mill from a natural to a portland cement plant. He became president of the company in 1914.

The many difficulties involved in the manufacture of the more exacting product first aroused that interest in the technical problems of both production and use of cement which has characterized his work in the Portland Cement Association and which won for him his ten-year chairmanship of the Committee on Technical Problems. The bearing of that committee's activities on the association's work is readily appreciated by recalling the technical basis which has underlaid the major efforts of the association. Outstanding in the committee's accomplishments is the establishment of the Structural Research Laboratory.

Civic Activities

Mr. Kelley's energies, though heavily drawn on by his principal business and his association duties, have extended to many other fields. A leader in his own business community, he is now president of the Albany Chamber of Commerce, vice-president of the Albany Hospital, trustee of the Albany Medical College, director of the National Commercial Bank & Trust Co., and trustee of the City Savings Institute. His services to the Albany Hospital have been especially notable in that with the support of the professional staff he has been instrumental in introducing business standards into the accounting and hotel features of the institution.

His varied business activities have been matched by his work in professional societies. He is a member of the A.S.M.E. (chairman of its Cement Section), the A.I.E.E., the A.S.T.M. (on the executive committee of C-1), of the Joint Committee on Concrete and Reinforced Concrete, the Albany Society of Engineers, and of the Society of Engineers of Eastern New York (holding the presidency this year).

Rounding out his many sidedness is a sustained interest in rowing at Cornell, an interest born of his year in the freshman and two years in the varsity boat and capped by a long presidency of the Cornell Crew Association. Characteristic of the man is his belief that he owes much of his business progress to this crew experience—robust health and never-to-be-forgotten lessons of teamwork and concentration.

North Carolina Water-Works Men Meet at Gastonia

Special Correspondence

The North Carolina Section of the American Water Works Association met at Gastonia, Nov. 14-16, on the lower floor of the city's new 2-m.g.d. water filtration plant. The registration was 120, of whom 47 were superintendents, filter plant operators, etc. This large attendance led to the hope that the section would retain for another year the Hill cup, given annually to the section of the parent association that shows the largest membership increase during the previous year.

The chief discussions were brought out by J. O. Craig on "Water Rates," by W. McK. Moffitt and J. S. Bennett on "Universal Pipe," by M. N. Boyles on "Experience with Wood Stave Pipe," and by W. D. Gates on "Water-Works Superintendents' Responsibility for Fire Fighting." Mr. Gates stated that in the recent serious fire in Atlanta, the threads on hydrants had been so badly worn by use of hydrants for street flushing that their service for fire fighting had been greatly impaired.

A non-technical talk on what hydrogen-ion determinations mean to the water-works operator and the lines along which studies are being prosecuted to make this determination of greater practical value was given by Dr. E. J. Theriault of the U. S. Public Health Service. G. H. Cattlett, sanitary engineer, State Board of Health, and George D. Norcom, sanitary engineer of the Wilmington Board of Health described some investigations being conducted in North Carolina on hydrogen-ion determinations. Whereas Dr. Theriault had found that a pH value of 5.5 gave generally optimum conditions for precipitation of a floc from aluminum sulphate in North Carolina waters, the pH value for good precipitation ranged from 4.2 at Wilmington to 6.6 at other places.

The officers elected for 1922-3 are: President, E. B. Bain, Raleigh; vice-president, J. O. Craig, Salisbury; secretary and treasurer Prof. Thorndike Saville, Chapel Hill, N. C. The next annual meeting will be held at New Bern.

Prizes Offered for Best Essays on Municipal Government

Competition for the Morton D. Hull and the William H. Baldwin prizes for the best essay on municipal government have been announced by the National Municipal League. The Hull prize of $250 is "for the best essay on a subject connected with municipal government" and is open to post-graduate students in municipal government in any college or university in the United States where courses in the subject are given. The Baldwin prize of $100 is open to undergraduate college or university students registered where direct instruction in municipal government is offered. The subjects for 1923 are: (1) City Managership as a Profession; (2) The Non-Partisan Movement in American Cities; (3) The Functions of Municipal Bureaus of Information, Complaint and Legal Aid. Baldwin prize essays must not be over 20,000 words and Hull prize essays not over 10,000 words in length. Competitions for the Baldwin prize close Sept. 15, 1923, and for the Hull prize April 15, 1923.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.
AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.
AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.
AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.
ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The New York State Assembly, American Association of Engineers, at its annual meeting held Nov. 11 at Albany, N. Y., elected the following officers: president, Gloster P. Hevenor, Rochester; first vice-president, W. L. Everett, New York; second vice-president, J. G. Norton, Binghamton, and secretary-treasurer, Lewis B. Smith, Rochester. The membership of the New York State Assembly is composed of the following chapters: New York City, Buffalo, Rochester, Albany, Binghamton, Utica, Hornell, Syracuse and Poughkeepsie. Total membership is about 2,000.

The Buffalo Section, American Society of Civil Engineers, at the bimonthly meeting on Nov. 23, was addressed by Gen. R. C. Marshall, jr., general manager of the Associated General Contractors of America, on "The Relation of the Engineer and Contractor in Construction." All the contractors of Buffalo and vicinity were invited as guests of the society.

PERSONAL NOTES

G. A. CRAYTON has resigned as office engineer with the South Dakota State Highway Commission and has accepted a similar position with the Illinois Division of Highways.

GEORGE HUBBELL, West Norwalk, Conn., has been appointed building inspector of the City of Norwalk, Conn.

W. B. HONSKA, formerly resident engineer in charge of federal-aid work in Republic County, Kan., has been appointed county engineer of Rawlins County, Kan.

CHARLES H. LEE has been appointed lecturer in civil engineering at the University of California for the year 1923 and will conduct the course in water-supply engineering ordinarily given by CHARLES GILMAN HYDE, professor of sanitary engineering, who will be absent from the university during the first half of 1923 on sabbatical leave. Mr. Lee will carry on the university work in addition to his regular consulting practice in San Francisco.

CHRIS P. JENSEN, county surveyor of Fresno County, Calif., is a candidate for the office of director of public works of the State of California, an appointive position. During his incumbency a reduction of $250,000 in engineering supervision of road work has been secured. Also he is credited with the victory over the Warren Bros. Co., paving contractors, resulting in a saving to the county of more than $200,000 in royalties on a type of pavement designed by Mr. Jensen which was claimed to be an infringement on the Warren patents. In 1909 Mr. Jensen was appointed city engineer of Fresno, occupying that position for four years. In 1919 he took the office of Fresno county surveyor which he has held since.

ROBERT ISHAM RANDOLPH, of the Randolph-Perkins Co., consulting engineers, Chicago, addressed the recent Chicago meeting of the Southern Commercial Congress, on "The Business and the Function of the Consulting Engineer." His purpose was to explain the important relation of the engineer and his work to public health and welfare, and to commercial progress.

J. S. BENTLEY, formerly a field engineer of the Kentucky State Highway Department, has been appointed county road engineer of Pike County, Ky., and will be in charge of road construction in that county after Jan. 1, 1923. This is Mr. Bentley's third appointment to this office, his first appointment having been made in 1916.

JOSEPH G. SHRYOCK has just been appointed chief engineer of the Belmont Iron Works, designers, manufacturers and exporters of structural steel with plants at Philadelphia and Eddystone, Pa. Mr. Shryock has been at various times in the bridge and construction department of the American Bridge Co.; the engineering department of the Virginia Bridge and Iron Works, Roanoke, Va., and with the Belmont Iron Works as designing engineer.

JOHN W. SHAFFER will succeed E. E. TERRELL as county engineer of Hennepin County, Minn., as a result of the general election held Nov. 7. Mr. Shaffer has maintained engineering offices in the New York Life Building in Minneapolis. Another change in county engineers will be that in Ramsay County, in which St. Paul is located, PAUL N. COATES having been elected to succeed R. R. GODFREY.

A. TRAVER NEWMAN, formerly with A. L. Webster, consulting civil engineer, New York City, has established consulting offices at 136 West 50th St., New York City. He will specialize in the preparation of plans and specifications for drainage, water supply, sewage disposal, supervision of installations, and special field identification of wrought iron and steel pipe. Prior to his association with Mr. Webster, Mr. Newman was with D. E. Waid, consulting architect for the Metropolitan Life.

W. M. VANDERSLUIS has been appointed electrical engineer for the Chicago electrification and terminal improvements of the Illinois Central R.R., succeeding Hugh Pattison. Mr. Vandersluis was formerly signal engineer of the Illinois Central R.R. and later secretary of the commission appointed by the railroad to decide upon the system of electrification, as noted in *Engineering News-Record*, Nov. 16, p. 841.

CHARLES L. ANDROS, who has been in the office of the New York Commission of Highways for several years, has resigned his position as engineer to take up the practice of law.

LORENZO C. DILKS, former vice-president of the George A. Fuller Co., New York City contractors, and prior to that president of the Carolina Shipbuilding Corp., and of Milliken Bros., Inc., has been made vice-president of Starrett Bros., Inc. The firm with which Mr. Dilks has lately become associated was recently organized to carry on a general contracting business. Mr. Dills' office will be in Chicago.

DANIEL C. COOPER, former city engineer of Elkins, W. Va., has been appointed construction superintendent with the United States Gypsum Co. He is located at Oakfield, N. Y.

JAMES C. F. SHAFER has established a construction firm in Cleveland that will handle industrial construction particularly. Mr. Shafer for the past ten years has been in that general line of work both in civilian and military life. When he entered the service prior to the beginning of the World War he was general manager of the Dayton office of the Structural Concrete Co. Since his discharge from the army he has been vice-president of the Boldt Construction Co., Cleveland.

OBITUARY

JOHN T. DALTON, of the firm of Ziegler and Dalton, general contractors of Junction City, Kan., died last week at his home in that city aged 67 years. Mr. Dalton's firm was widely known for construction work throughout the country at U. S. Army posts.

LAWSON BENNETT BIDWELL, who retired in 1905 from active professional service, died in his home in Hyde Park, Boston, Nov. 19, aged 90 years. Mr. Bidwell was a former president of the Boston Society of Civil Engineers, had served as park commissioner of Hyde Park and had been active in railroad engineering in New England for a number of years prior to his retirement. He started engineering work with the Hartford, Providence and Fishkill R.R. at the age of 19. Subsequently, he became assistant engineer of the road, leaving in 1863 to work upon the construction of the Union Pacific R.R. He returned the following year to the Hartford, Providence and Fishkill, becoming chief engineer of that road eventually, in which position he continued until 1898 when that road was absorbed by the New York, New Haven & Hartford. He then became assistant engineer in charge of one-half of the system.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Federation Report Against 12-Hour Day

Three-Shift System Favored as Result of Survey of Forty Continuous Industries

RESULTS of a survey of forty continuous industries made by the Committee on Work-Periods in Continuous Industry of the Federated American Engineering Societies bear out the contention of John D. Rockefeller, Jr., that the two-shift system with its 12-hr. day is economically unnecessary and socially unwise. In a statement just issued by Dean Mortimer E. Cooley, of the University of Michigan, it was asserted that the views of Mr. Rockefeller represented "a tendency prevailing throughout the world" and that the United States was falling in line with Europe and Asia. The findings of the engineering committee, according to Bradley Stoughton, chairman of the Iron and Steel Committee of the American Institute of Mining and Metallurgical Engineers, applied generally to the steel industry.

Mr. Stoughton, formerly adjunct professor of metallurgy in Columbia University, conducted a special inquiry into hours of labor in the steel industry and reached the conclusion that three shifts of 8 hr. each should be adopted both from the standpoint of the industry itself and of the general public.

Favor Three Shifts

Horace B. Drury, of Washington, former member of the faculty of Ohio State University, who directed the general investigation of the engineering federation, asserted that, while "there is a natural divergence of opinion as to the advantages and disadvantages of the three-shift operation, the weight of the evidence and the most positive statements are in favor of the three-shift operation."

Dr. H. E. Howe of the National Research Council, Washington, who was chairman of the engineering federation's Committee on Work-Periods, said that the engineering view, based upon two years of scientific inquiry, was shared by high officials at Washington. Dr. Howe predicted that the engineering report on hours of labor, which, he said, would soon be presented in complete form, would engender industrial experimentation that might prove of advantage to the nation. The work of the engineer, he said, should be a large factor in bringing about a closer understanding between capital and labor.

J. Parke Channing and L. P. Alford, members of the Committee on Work-Periods, said that the general advantages accruing from the 8-hr. day compensated for any extra cost involved in the transition from the two-shift system of 12 hr.

Brick Manufacturers to Meet

The National Brick Manufacturers Association will hold its annual convention at Cleveland, Feb. 5-10, 1923.

To Show Centrifugal Process of Making Pipe in Movie

The centrifugal process for the manufacture of cast-iron pipe will be illustrated in a moving picture at the luncheon meeting, Dec. 6, of the New York Section of the American Water-Works Association. The session is scheduled for 12:30 p.m. on the eighth floor of the Palais des Beaux Arts, 40th St. and 6th Ave. After the picture has been shown there will be general discussion.

Engineers End Discussion of Winter Buying of Pipe

Opinion Indicates Feasibility of Equalizing Demand by Cutting Seasonal Peak

BELOW is given the concluding discussion by water-works engineers of the proposal made in *Engineering News-Record* of Oct. 19, p. 675, to reduce the cost of production of cast-iron pipe by equalizing the demand throughout the entire year instead of concentrating orders for delivery during the summer months:

In next week's issue the manufacturers of cast-iron pipe will submit a statement in rebuttal to the comment by the users of pipe and will make an important announcement of policy whereby both manufacturer and buyer will benefit.—Editor.

CALEB M. SAVILLE
Manager and Chief Engineer,
Board of Water Commissioners,
Hartford, Conn.

From a manufacturer's standpoint the spreading of pipe purchases over the entire year would undoubtedly tend to lower production cost. Whether or not this would be appreciably reflected in the price to the consumer is problematical. From the theoretical viewpoint of conservation and as tending toward that general economy and efficiency of production which seems to offer the best means for promoting deflation of currency and lowering the price levels of commodities, the proposition of the pipe manufacturers seems basically sound. What is needed now is a practical working connection between producer and consumer—constructive suggestions. What follows is along the line of destructive criticism, but it is presented more as a warning of pitfalls than as an argument against the suggestion.

From the consumer's point of view, in the northeastern section at any rate, I am unable to find any benefit, and my observation would indicate increased costs and lessened economy. The desirability of avoiding disruption of pipe-laying gangs by cessation of

(Continued on p. 954)

Fabricators Form Institute of Steel Construction

Chief Work Will Be to Standardize Working Stresses and Design Tables

AFTER a year of active organizing work since its formation in 1921 the National Steel Fabricators' Association, at its meeting in Pittsburgh Nov. 23, changed its name to American Institute of Steel Construction in order to give better expression to the range of activities which the organization proposes to take up. Its present membership is 113 fabricating shops. J. L. Kimbrough was elected president, W. M. Wood vice-president and treasurer and the following as new directors: C. W. Russell, H. A. Dyer, A. B. Klingelhofer, C. A. Schneider, W. M. Wood and G. E. J. Pistor. L. H. Miller continues as managing director.

Addresses to the meeting were made by M. B. Lane, of the Census Bureau, and W. A. Durgin, of the Division of Simplified Practice, Department of Commerce. Mr. Lane requested the institute to co-operate with the Census Bureau in collecting data and statistics relating to the structural steel fabricating industry. Mr. Durgin offered the aid of the Department of Commerce in establishing uniform unit stresses and uniform practices, and in bringing about a reduction in the number of rolled sections used in the industry with a view to reducing the enormous industrial waste of the nation.

The principal work to be undertaken by the institute during the next year is the formulation of standard working stresses for structural work and for tanks, and the preparation of design tables for all steel sections based on these stresses; agitation for the adoption of uniform building law provisions relating to steel; extension of the uses of steel; and the discussion of questions arising between steel users and fabricators, such as uniform calculation of contract weights of steel.

A total producing capacity of about 2,000,000 tons of steel per year is represented in the institute, with an average of nearly 16,000 tons per shop. Records gathered by the managing director indicate that despite a steady growth in the country's fabricating capacity there has been 50 per cent decrease in the use of structural steel in the nine years from 1912 to 1921. Much of this decrease is believed chargeable to restrictive conditions unrelated to efficient building, which the institute will aim to change.

Invoke Anti-Dumping Law Against Canadian Building Felts

The Treasury Department has issued an order under the anti-dumping act against roofing and deadening felts imported from British Columbia, acting on information that such importations tend to injure the industry of manufacturing building felts in the United States. It was reported to the department that the imports were being sold at less than their fair value. Under the act, collectors of customs will place an additional duty on each importation of such felts, sufficient to equalize the price at which they are sold in the home market and in the United States.

End Discussion of Winter Buying of Cast-Iron Pipe

(*Concluded from p. 953*)

work during winter is often a problem of moment. Several years ago the plan was tried of working the pipe gangs after the frost had gone well into the ground. Streets were chosen where conditions were similar to those on work done during the summer and sufficient work was done to be assured that a fair comparison could be made. The cost was found to be about 15c. per foot more than in the summer—say between 9 and 10 per cent increase. To meet such increase on the basis of $55 per ton of pipe the foundry would have to offer a reduction of at least $6.32 per ton (0.15 x 2000/47.5 lb. per ft.) of Class B 8-in. pipe.

In Connecticut from the middle of December to the middle of March ordinarily there is frozen ground to a depth of from 3 to 4 ft. and in exceptional years it will go a foot lower. Excavated material thrown on the bank freezes solid during the night and will not usually thaw out during the day sufficiently to be shoveled without picking. When possible to pick out it is in lumps with size depending on the time taken to break it up. Backfilling with these lumps leaves a high and dangerous trench unless a large portion is left out. When the frost goes out in the spring there is considerable settlement which must be filled at an additional cost to the work. This phase is not included in the cost difference above.

Winter's Effect on Labor

The cost of trench work is only one item. Labor as a whole is much less efficient on cold days with short daylight than during the summer. When main and service pipe work is necessary under pavements in the winter time it is often necessary to entirely backfill with unfrozen gravel or sand brought from a distance, and then haul away the excavated material. This adds still another item to the cost. Comparatively little pipe is laid in swampy ground, but with a pair of horses and a stone boat for small jobs, and a caterpillar tractor if the work warrants, the cost of hauling would be about as cheap in summer as in winter, even if the soft places did not dry out. Besides this the danger of loss from breaking pipe in handling is less in summer than in winter.

It might be inferred from some of the text that much pipe is installed in country byways, or through uninhabited localities. In New England most of the pipe is laid in property developments, except supply mains, and is not laid then until there is a considerable prospect of getting proper returns. This means that the streets are laid out, often rough-graded, and must be left in passable condition, which is much easier of accomplishment in summer than in winter.

As to buying early and stringing out a long pipe line: At $55 per ton for pipe at f.o.b. Hartford, for every month that 8-in. pipe lies on or in the ground without use there is an added cost of 1c. per linear foot (1.32 x 0.06/12), or about 28c. per ton per month, for interest (6 per cent). For four months' receipt prior to laying this would amount to $1.12 per ton. In order, therefore, for it to be an attractive proposition to lay in a stock of pipe much in advance the purchaser would have to be assured that he was getting his pipe at least a dollar or so a ton less than it could be purchased in the spring. Under present conditions there seems no inducement for a consumer to purchase in the fall for use four or six months ahead, with no certainty that the base price may not be less the following spring.

The matter of a working connection between manufacturer and consumer presents many difficulties. As a suggestion, however, possibly the pipe manufacturer, in order to get work for the winter and make deliveries during that season rather than stock up his own yard, would be willing to bid on a discount from the market price in the spring. I realize that many objections will at once occur to many readers and probably they will have sufficient weight to render this proposition untenable. Nevertheless, if the suggestion of the pipe manufacturers is a sound one, and in principle it seems to be so, some way will be found to put it into practice.

From a water-works management viewpoint, it appears to the writer that in the northeastern portion of the country at least maximum efficiency and economy are best served by keeping watch of the market; purchasing only so far ahead in late fall as will give a reasonable supply of pipe for beginning work in the spring; placing ample orders for pipe early in the spring for definite delivery; and following these orders energetically to be assured that some more active or insistent pipe customer does not get his order run in ahead of yours at the foundry; and finally, prompt payment of pipe bills.

Plans Complete for Power Show

Arrangements have been completed for the National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, Dec. 7-13. While the fundamental purpose of the exposition is to bring together exhibits of various manufactures of power and mechanical equipment so that engineers and executives may have an opportunity of becoming acquainted with the latest devices, the advisory committee has also kept in mind the need for a greater understanding of the importance of power and the need for the conservation of the resources used in power development. Accordingly, the educational nature of the exposition has been stressed.

The large number of technical societies interested in power and mechanical engineering problems have been invited to attend. Members of these societies will be admitted on displaying their badges or membership cards.

October Motor-Truck Production Shows Increase

Production of motor vehicles in the United States during October of this year exceeded September's production by 20 per cent, according to a report received Nov. 1 at a meeting of directors of the National Automobile Chamber of Commerce in New York. The total output for October is estimated at 244,000 cars and trucks; the best previous October record was 200,000 in 1919.

C. L. Berger's Death Ends Career of Noted Instrument Maker

Christian Louis Berger, well known as a maker of surveying and scientific instruments and head of the firm of C. L. Berger & Sons, Boston, died Nov. 19. While engineers are more familiar with the transits and levels which the Berger organization manufactured, other types of instrument developed by Mr. Berger were those for astronomical observations, current meters, pendulum apparatus, micrometers, spectrometers, and deep-sea thermographs used in sounding sea bottom. It was with instruments produced at the Berger factory that Rear-Admiral Peary made his observations during his expedition to the North Pole in 1909.

Mr. Berger was born in Stuttgart, Germany, Sept. 26, 1842. At the age of fourteen he was apprenticed to Christian Saeger, the well-known manufacturer of surveying instruments and chemists' scales, where he remained four years. From that time until he came to the United States in 1866 he served with the master instrument makers of Germany and England, including G. Schubart of Marburg, Breithaupt & Sons of Cassell, J. Lohmeyer of Hamburg, A. & G. Repsold, and Cook & Sons, of York, England.

Arriving in Boston at the age of twenty-four he became associated with E. S. Ritchie, of Brookline, Mass., manufacturer of physical and mathematical apparatus and nautical instruments. Here he served four years and after one year at John Upham's instrument establishment in Boston he entered business for himself in Boston in 1871 as a manufacturer of surveying, engineering, mining and astronomical instruments. Here, in a one-room establishment, began the growth of the business which has made the name of Berger a byword among engineers and scientists and has resulted in a manufacturing plant covering an extensive site in Roxbury, Mass.

In 1898 Mr. Berger took into partnership his two sons, William A. and Louis H., the firm name becoming C. L. Berger & Sons. Plans for enlargement of the present plant are now under consideration.

Business Notes

Arthur P. Denton has resigned as sales manager, Pacific Portland Cement Co., to become district engineer for the Portland Cement Association with headquarters at the San Francisco office.

Frank Nickerson, for nine years connected with the San Francisco office of the Midvale-Cambria Steel Co., has severed his connections with that company to accept the position as southern California manager for the Bethlehem Steel Corp. about Jan. 1 with an office in the Washington Building, Los Angeles.

Power Specialty Co., New York, builders of Foster superheaters, economizers and oil heating and cooling equipment, announces the opening of new branch offices in the Dime Savings Bank Building, Detroit, in charge of L.

Lanyi, and at 2324 Fourteenth St., Boulder, Colo., in charge of R. B. Nutting, who was formerly Chicago district manager.

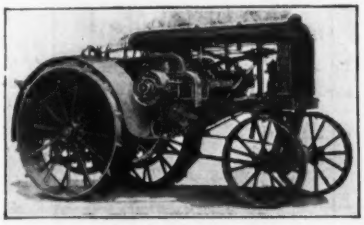
GENERAL MOTORS TRUCK CO., Pontiac, Mich., announces the appointment of Harry S. Whitehair to its national sales division. He will devote his time to sales to national organizations which use large fleets of trucks in all section of the country, paying special attention to companies which have headquarters outside of New York and Chicago, where other national sales division representatives are stationed.

Equipment and Materials

Improved Tractor Has Increased Power and Direct Drive

As a feature of its 1923 line of construction equipment the Avery Co., Peoria, Ill., announces the improved 20-35 hp. tractor. As shown in the accompanying view of this new model the cab has been eliminated, the fenders cover the full width of the rear wheel and extend from the platform more than half their circumference.

The hood running back from the radiator incorporates the fuel tanks



and affords a cover protection for the motor. The tractor is finished in French gray with red wheels.

Chief among the improvements in this model are the increasing of the power of the motor by 25 per cent, the adoption of a cooling system with cellular radiator, water pump and fan, and the use of the Madison Kipp mechanical lubricator for oiling the working parts of the motor. The tractor has a 4-cylinder opposed Avery motor with bore and stroke now 4¼ x 7 in. It has valves-in-head, renewable inner cylinder walls, centrifugal gasifier for burning kerosene, adjustable main crankshaft bearings and extra large crankshaft.

This machine also has the direct-drive transmission by means of which all the power of the motor is delivered to the belt and the greatest per cent in the drawbar. The weight of the tractor is 7,500 lb., making it, according to its manufacturer, one of the lightest weight tractors per drawbar efficiency.

Self-Propelling Nozzles for Cleaning Sewers

For removing obstructions in sewers and drains a revolving self-propelling nozzle has been developed by the Self-Propelling Nozzle Co., Inc., New York. It is made of bronze and consists of two castings, one threaded to connect with pipe or hose and the other the nozzle head. The parts are connected by a ball bearing swivel. The head, in which are a series of diagonal vanes to produce a rotary motion, has a small opening at the front and a series of larger holes at the rear, as shown in the accompanying drawing. Streams of water escaping through the rear holes propel the nozzle forward, while the stream from the forward opening loosens the material in the line of

travel. A pressure of at least 25 lb. per square inch is required for the efficient operation of this tool. The nozzles are manufactured in two sizes, the first with an outside diameter of 2½ in. and the second with an outside diameter of 3¾ in.

In using the nozzle it is customary to attach one end of the hose to a fire hydrant and insert the nozzle at the other end into the opening to be cleared. When water is turned on the nozzle travels under its own po r until it reaches an obstruction, dragging the hose after it. The forward stream of water bores a hole into any soft material in its path while the rear streams break up the blockade and wash it away. This nozzle has also been used for boring into piles of soft coal and extinguishing fires.

New Type of Rivet-Cutter

On the principle that when cutting rivets, a number of comparatively light, rapid blows cause more vibration and therefore more distortion of steel plates than a few intermittent, heavy blows, the Chicago Pneumatic Tool Co., New York, has designed and manufactured a new type of rivet-cutter known as the "Boyer Superior." It consists of a dead handle, a throttle handle of the crank design, a throttle valve of the taper type, a back head screwed onto the cylinder and secured by a locking device, a cushion chamber in the rear end of the cylinder, a cylinder of seamless steel tubing, a bypass from back to front head, a non-removable electri-

cally welded front head, square coiled spring buffer, adjustable chisel lock, hand hold of the spade handle type, and chisel.

To operate, the throttle handle is moved in a line parallel with the cylinder. Each forward and return stroke of the piston is hand-controlled. About four blows requiring approximately 10 to 15 sec. are required to cut off the head of a ¾-in. rivet. Two men are required to operate the machine.

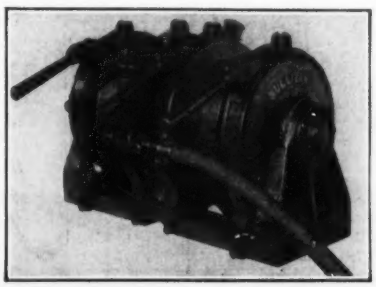
The machine is made in two types, standard and special, the weights (with chisel) being, respectively, 78½ and 86½ lb., and the overall lengths 69 11/16 and 74 11/16 in. An air pressure of 100 lb. per square inch is required and for both types the piston diameter is 2 in. and the length of stroke 29½ in.

Light Double-Drum Compressed-Air Hoist

While designed primarily for mining operations, such as hauling ore scrapers or slushing, the 6½-hp. portable, double-drum compressed-air hoist just announced by the Sullivan Machinery Co., Chicago, is adapted to industrial and construction purposes within its capacity. A Turbinair motor supplies power to the two hoisting drums, each 10¾ in. in diameter. A driving pinion at each end of the motor casing engages an internal gear in each drum shell. The two drums are controlled independently by friction clutches and band brakes and may be operated separately or together.

The hoist weighs only 555 lb., or about 85 lb. per hp., is 29 in. long by 15 in. wide and stands 18½ in. high. Each drum holds 225 ft. of ⅜-in. wire rope. Either drum is capable of lifting 2,000 lb. dead weight vertically with 76 lb. of air pressure at a speed of 110 ft. per minute. Sufficient air can be supplied to the machine through a ¾-in. hose line to develop the machine's rating of 6½ hp.

The manufacturers point out that the hoist may be used on broom derricks where one drum is used for hoisting



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End Discussion of Winter Buying of Cast-Iron Pipe

(*Concluded from p. 953*)

work during winter is often a problem of moment. Several years ago the plan was tried of working the pipe gangs after the frost had gone well into the ground. Streets were chosen where conditions were similar to those on work done during the summer and sufficient work was done to be assured that a fair comparison could be made. The cost was found to be about 15c. per foot more than in the summer—say between 9 and 10 per cent increase. To meet such increase on the basis of $55 per ton of pipe the foundry would have to offer a reduction of at least $6.32 per ton (0.15 x 2000/47.5 lb. per ft.) of Class B 8-in. pipe.

In Connecticut from the middle of December to the middle of March ordinarily there is frozen ground to a depth of from 3 to 4 ft. and in exceptional years it will go a foot lower. Excavated material thrown on the bank freezes solid during the night and will not usually thaw out during the day sufficiently to be shoveled without picking. When possible to pick out it is in lumps with size depending on the time taken to break it up. Backfilling with these lumps leaves a high and dangerous trench unless a large portion is left out. When the frost goes out in the spring there is considerable settlement which must be filled at an additional cost to the work. This phase is not included in the cost difference above.

Winter's Effect on Labor

The cost of trench work is only one item. Labor as a whole is much less efficient on cold days with short daylight than during the summer. When main and service pipe work is necessary under pavements in the winter time it is often necessary to entirely backfill with unfrozen gravel or sand brought from a distance, and then haul away the excavated material. This adds still another item to the cost. Comparatively little pipe is laid in swampy ground, but with a pair of horses and a stone boat for small jobs, and a caterpillar tractor if the work warrants, the cost of hauling would be about as cheap in summer as in winter, even if the soft places did not dry out. Besides this the danger of loss from breaking pipe in handling is less in summer than in winter.

It might be inferred from some of the text that much pipe is installed in country byways, or through uninhabited localities. In New England most of the pipe is laid in property developments, except supply mains, and is not laid then until there is a considerable prospect of getting proper returns. This means that the streets are laid out, often rough-graded, and must be left in passable condition, which is much easier of accomplishment in summer than in winter.

As to buying early and stringing out a long pipe line: At $55 per ton for pipe at f.o.b. Hartford, for every month that 8-in. pipe lies on or in the ground without use there is an added cost of 1c. per linear foot (1.32 x 0.06/12), or about 28c. per ton per month, for interest (6 per cent). For four months' receipt prior to laying this would amount to $1.12 per ton. In order, therefore, for it to be an attractive proposition to lay in a stock of pipe much in advance the purchaser would have to be assured that he was getting his pipe at least a dollar or so a ton less than it could be purchased in the spring. Under present conditions there seems no inducement for a consumer to purchase in the fall for use four or six months ahead, with no certainty that the base price may not be less the following spring.

The matter of a working connection between manufacturer and consumer presents many difficulties. As a suggestion, however, possibly the pipe manufacturer, in order to get work for the winter and make deliveries during that season rather than stock up his own yard, would be willing to bid on a discount from the market price in the spring. I realize that many objections will at once occur to many readers and probably they will have sufficient weight to render this proposition untenable. Nevertheless, if the suggestion of the pipe manufacturers is a sound one, and in principle it seems to be so, some way will be found to put it into practice.

From a water-works management viewpoint, it appears to the writer that in the northeastern portion of the country at least maximum efficiency and economy are best served by keeping watch of the market; purchasing only so far ahead in late fall as will give a reasonable supply of pipe for beginning work in the spring; placing ample orders for pipe early in the spring for definite delivery; and following these orders energetically to be assured that some more active or insistent pipe customer does not get his order run in ahead of yours at the foundry; and finally, prompt payment of pipe bills.

Plans Complete for Power Show

Arrangements have been completed for the National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, Dec. 7-13. While the fundamental purpose of the exposition is to bring together exhibits of various manufactures of power and mechanical equipment so that engineers and executives may have an opportunity of becoming acquainted with the latest devices, the advisory committee has also kept in mind the need for a greater understanding of the importance of power and the need for the conservation of the resources used in power development. Accordingly, the educational nature of the exposition has been stressed.

The large number of technical societies interested in power and mechanical engineering problems have been invited to attend. Members of these societies will be admitted on displaying their badges or membership cards.

October Motor-Truck Production Shows Increase

Production of motor vehicles in the United States during October of this year exceeded September's production by 20 per cent, according to a report received Nov. 1 at a meeting of directors of the National Automobile Chamber of Commerce in New York. The total output for October is estimated at 244,000 cars and trucks; the best previous October record was 200,000 in 1919.

C. L. Berger's Death Ends Career of Noted Instrument Maker

Christian Louis Berger, well known as a maker of surveying and scientific instruments and head of the firm of C. L. Berger & Sons, Boston, died Nov. 19. While engineers are more familiar with the transits and levels which the Berger organization manufactured, other types of instrument developed by Mr. Berger were those for astronomical observations, current meters, pendulum apparatus, micrometers, spectrometers, and deep-sea thermographs used in sounding sea bottom. It was with instruments produced at the Berger factory that Rear-Admiral Peary made his observations during his expedition to the North Pole in 1909.

Mr. Berger was born in Stuttgart, Germany, Sept. 26, 1842. At the age of fourteen he was apprenticed to Christian Saeger, the well-known manufacturer of surveying instruments and chemists' scales, where he remained four years. From that time until he came to the United States in 1866 he served with the master instrument makers of Germany and England, including G. Schubart of Marburg, Breithaupt & Sons of Cassell, J. Lohmeyer of Hamburg, A. & G. Repsold, and Cook & Sons, of York, England.

Arriving in Boston at the age of twenty-four he became associated with E. S. Ritchie, of Brookline, Mass., manufacturer of physical and mathematical apparatus and nautical instruments. Here he served four years and after one year at John Upham's instrument establishment in Boston he entered business for himself in Boston in 1871 as a manufacturer of surveying, engineering, mining and astronomical instruments. Here, in a one-room establishment, began the growth of the business which has made the name of Berger a byword among engineers and scientists and has resulted in a manufacturing plant covering an extensive site in Roxbury, Mass.

In 1898 Mr. Berger took into partnership his two sons, William A. and Louis H., the firm name becoming C. L. Berger & Sons. Plans for enlargement of the present plant are now under consideration.

Business Notes

ARTHUR P. DENTON has resigned as sales manager, Pacific Portland Cement Co., to become district engineer for the Portland Cement Association with headquarters at the San Francisco office.

FRANK NICKERSON, for nine years connected with the San Francisco office of the Midvale-Cambria Steel Co., has severed his connections with that company to accept the position as southern California manager for the Bethlehem Steel Corp. about Jan. 1 with an office in the Washington Building, Los Angeles.

POWER SPECIALTY CO., New York, builders of Foster superheaters, economizers and oil heating and cooling equipment, announces the opening of new branch offices in the Dime Savings Bank Building, Detroit, in charge of L.

Lanyi, and at 2324 Fourteenth St., Boulder, Colo., in charge of R. B. Nutting, who was formerly Chicago district manager.

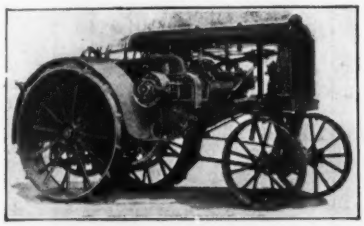
GENERAL MOTORS TRUCK CO., Pontiac, Mich., announces the appointment of Harry S. Whitehair to its national sales division. He will devote his time to sales to national organizations which use large fleets of trucks in all section of the country, paying special attention to companies which have headquarters outside of New York and Chicago, where other national sales division representatives are stationed.

Equipment and Materials

Improved Tractor Has Increased Power and Direct Drive

As a feature of its 1923 line of construction equipment the Avery Co., Peoria, Ill., announces the improved 20-35 hp. tractor. As shown in the accompanying view of this new model the cab has been eliminated, the fenders cover the full width of the rear wheel and extend from the platform more than half their circumference.

The hood running back from the radiator incorporates the fuel tanks



and affords a cover protection for the motor. The tractor is finished in French gray with red wheels.

Chief among the improvements in this model are the increasing of the power of the motor by 25 per cent, the adoption of a cooling system with cellular radiator, water pump and fan, and the use of the Madison Kipp mechanical lubricator for oiling the working parts of the motor. The tractor has a 4-cylinder opposed Avery motor with bore and stroke now 4¼ x 7 in. It has valves-in-head, renewable inner cylinder walls, centrifugal gasifier for burning kerosene, adjustable main crankshaft bearings and extra large crankshaft.

This machine also has the direct-drive transmission by means of which all the power of the motor is delivered to the belt and the greatest per cent in the drawbar. The weight of the tractor is 7,500 lb., making it, according to its manufacturer, one of the lightest weight tractors per drawbar efficiency.

Self-Propelling Nozzles for Cleaning Sewers

For removing obstructions in sewers and drains a revolving self-propelling nozzle has been developed by the Self-Propelling Nozzle Co., Inc., New York. It is made of bronze and consists of two castings, one threaded to connect with pipe or hose and the other the nozzle head. The parts are connected by a ball bearing swivel. The head, in which are a series of diagonal vanes to produce a rotary motion, has a small opening at the front and a series of larger holes at the rear, as shown in the accompanying drawing. Streams of water escaping through the rear holes propel the nozzle forward, while the stream from the forward opening loosens the material in the line of

travel. A pressure of at least 25 lb. per square inch is required for the efficient operation of this tool. The nozzles are manufactured in two sizes, the first with an outside diameter of 2½ in. and the second with an outside diameter of 3¾ in.

In using the nozzle it is customary to attach one end of the hose to a fire hydrant and insert the nozzle at the other end into the opening to be cleared. When water is turned on the nozzle travels under its own po r until it reaches an obstruction, dragging the hose after it. The forward stream of water bores a hole into any soft material in its path while the rear streams break up the blockade and wash it away. This nozzle has also been used for boring into piles of soft coal and extinguishing fires.

New Type of Rivet-Cutter

On the principle that when cutting rivets, a number of comparatively light, rapid blows cause more vibration and therefore more distortion of steel plates than a few intermittent, heavy blows, the Chicago Pneumatic Tool Co., New York, has designed and manufactured a new type of rivet-cutter known as the "Boyer Superior." It consists of a dead handle, a throttle handle of the crank design, a throttle valve of the taper type, a back head screwed onto the cylinder and secured by a locking device, a cushion chamber in the rear end of the cylinder, a cylinder of seamless steel tubing, a bypass from back to front head, a non-removable electri-

cally welded front head, square coiled spring buffer, adjustable chisel lock, hand hold of the spade handle type, and chisel.

To operate, the throttle handle is moved in a line parallel with the cylinder. Each forward and return stroke of the piston is hand-controlled. About four blows requiring approximately 10 to 15 sec. are required to cut off the head of a ¾-in. rivet. Two men are required to operate the machine.

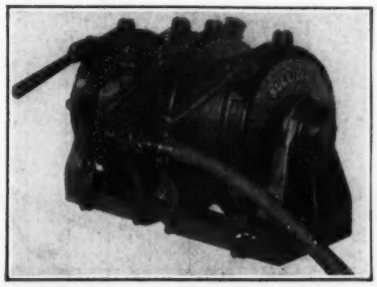
The machine is made in two types, standard and special, the weights (with chisel) being, respectively, 78½ and 86½ lb., and the overall lengths 69½ and 74½ in. An air pressure of 100 lb. per square inch is required and for both types the piston diameter is 2 in. and the length of stroke 29½ in.

Light Double-Drum Compressed-Air Hoist

While designed primarily for mining operations, such as hauling ore scrapers or slushing, the 6½-hp. portable, double-drum compressed-air hoist just announced by the Sullivan Machinery Co., Chicago, is adapted to industrial and construction purposes within its capacity. A Turbinair motor supplies power to the two hoisting drums, each 10¾ in. in diameter. A driving pinion at each end of the motor casing engages an internal gear in each drum shell. The two drums are controlled independently by friction clutches and band brakes and may be operated separately or together.

The hoist weighs only 555 lb., or about 85 lb. per hp., is 29 in. long by 15 in. wide and stands 18½ in. high. Each drum holds 225 ft. of ⅜-in. wire rope. Either drum is capable of lifting 2,000 lb. dead weight vertically with 76 lb. of air pressure at a speed of 110 ft. per minute. Sufficient air can be supplied to the machine through a ¾-in. hose line to develop the machine's rating of 6½ hp.

The manufacturers point out that the hoist may be used on broom derricks where one drum is used for hoisting



the load and the other for operating the broom. The outfit also is useful on scraper loader work, removing such materials as coal, sand, gravel and crushed stone. One of these hoists has been employed for hauling broken stone up an incline to a crusher. The double-drum feature is useful in work of this sort because one drum can be used for hauling the live load and the other for returning the empty scraper to the loading point.

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Business Side of Construction

Facts and Events that Affect Cost and Volume

Construction Cost and Volume Compared

Prices Now High and Fairly Steady—This a "Normal" Year; Only Necessary Construction in 1921

During 1921 general construction cost declined steadily from February to October. The decline was abrupt, amounting to 65 points or 28 per cent. Then prices began to stiffen, until the slump in February, since which time the tendency has been upward. The average *E. N.-R.* Construction Cost Index Number for the eleven months of this year is 173.4, while since Oct. 1 the number has been 188.60.

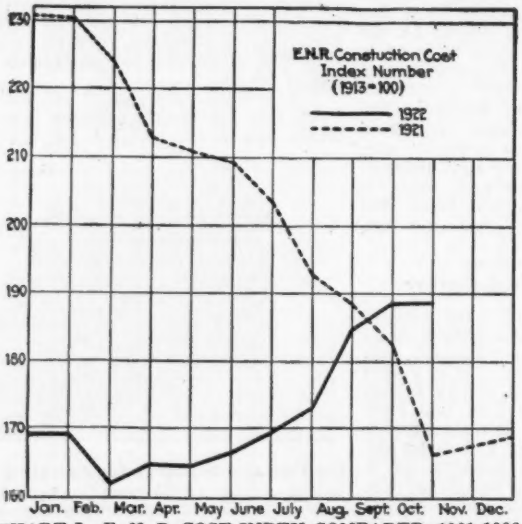


CHART I—*E. N.-R.* COST INDEX COMPARED, 1921-1922

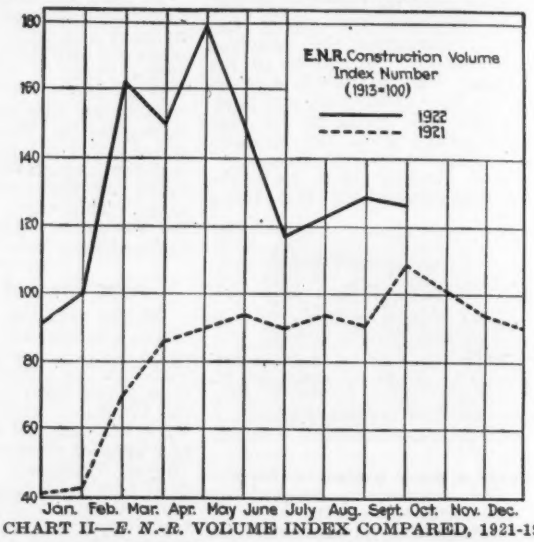


CHART II—*E. N.-R.* VOLUME INDEX COMPARED, 1921-1922

Indications point toward the present price level being maintained for some time to come. With the passing of the peak of car loadings (October) and when a sufficient number of freight cars are available it is quite possible that lumber prices will decline. Steel and cement prices are holding firm. The trend of labor rates is problematical and depends to a large extent upon the correctness of the American Federation of Labor's contention that there is no shortage of labor, either the skilled or unskilled. The United States Bureau of Labor Statistics and other statistical agencies claim that there is a labor shortage. In either event it is unlikely that labor will be further deflated at this time.

With respect to construction volume, the 1921 trend and the 1922 trend of contracts awarded as given by the *E. N.-R.* Construction Volume Index Number, are compared in Chart II. Clearly, this is a much better construction year than last. The 1921 curve is fairly smooth, indicatng that the bulk of the work was of a necessary character. Its appearance is spiritless. This year, on the other hand, there was a very evident and prolonged boom, with sub-booms. The 1922 curve gives an appearance of healthy activity that shows that the construction industry has regained interest in itself. The two curves have totally different characteristics, for the reason that 1922 may be called a "normal" year, whereas last year was one of only necessary construction.

A New Theory of Business Cycles

A unique and rather convincing theory of Business Cycles is brought out in the *Annalist*, November 13, 1922, by Richard H. Tingley in which he analyzes the six cycles with their seven crises or panics which have occurred since the Civil War.

This is done by means of several diagrams on which have been plotted, month by month and year by year, the ratio found to exist between loans and discounts on the one hand, and deposits on the other, in certain important commercial banks.

On one of the diagrams this ratio is shown as made by all of the national banks of the country. On another, the same ratio referring to the banks belonging to the New York Clearing House. In every instance it is clearly shown that the seven crises have been approached by a sharply rising ratio of loans and discounts to deposits—in other words, as the banks have continued to loan more and more money than they have on deposit, a crisis is precipitated and liquidation ensues.

Mr. Tingley suggests that, since his principle has been found to work with unerring accuracy over a period of fifty-seven years which include seven crises, it may be profitable for business men to keep track of this ratio, week by week, as it is easily read in the daily prints, and he introduces a final diagram, which was reproduced in *Engineering News-Record*, Nov. 16, p. 864, showing the progress of this ratio during the present year. The diagram shows that the ratio, having fallen sharply, is now on the rise, throwing out its warning signal as it does so.

In the *News-Record* excerpt it was clear that if it were possible to obtain the total loans and the total deposits of all the banks in the United States at any given minute the result would be very close to 100—or parity. But a large number of these are not commercial banks and Mr. Tingley has confined his analysis to such, only, choosing for his purpose the really crucial banks of that character as representative of the trend of the country's business.

Car Loadings Drop 4 Per Cent and Shortages 2 Per Cent in Week

Loading of revenue freight continues at the present time to be the heaviest in the history of American railroads, according to reports received from the carriers by the American Railway Association.

For the week ending Nov. 11, loadings totaled 953,909 cars, which is an increase of 198,132 compared with the corresponding week last year, and an increase of 26,323 compared with the corresponding week in 1920. The total, however, was a decrease of 40,918 cars compared with the preceding week due to Election Day and the observance of Armistice Day throughout the country, both of which took place during the week of Nov. 11. Coke loadings totaled 12,273 cars, 632 above the week before. Compared with the same week last year, this was an increase of 5,896 cars, but a decrease of 2,837 cars compared with the same week two years ago. Forest products amounted to 60,392 cars, a gain of 379 over the preceding week, and an increase of 9,626 above last year. Compared with the same week in 1920 this also was an increase of 4,136 cars.

Coal loadings for the week ending Nov. 18, reached 238,833 cars, a new record for any single week since the termination of the miners' strike.

Car shortages, on all lines throughout the United States, for the week ending Nov. 8, totaled 174,498 as against 179,239 for the week of Oct. 31; this represents a drop of 2 per cent.

"Fair Minimum American Standard of Living"

Cost of maintaining a "fair minimum American standard of living" (which, however, is not necessarily a measure of the minimum wage) in Lawrence, Mass., the result of a field study of actual conditions prevailing among mill workers' families in June, 1922, at height of textile strike, made by the National Industrial Conference Board, is given in the accompanying table. These figures measure only minimum cost of living and allow nothing for saving.

MINIMUM COSTS IN LAWRENCE, MASS., MILL DISTRICT

	Parents and 1 child		2 Children		3 Children	
	Year	Week	Year	Week	Year	Week
Clothing	$167.36	$3.22	$197.64	$3.80	$227.92	$4.38
Food	304.20	5.85	384.80	7.40	465.40	8.95
Rent	208.00	4.00	260.00	5.00	260.00	5.00
Fuel and light	79.88	1.54	82.70	1.59	82.70	1.59
Sundries	163.28	3.14	200.20	3.85	237.12	4.56
	$922.72	$17.75	$1,125.34	$21.64	$1,273.14	$24.48

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 279 to 290, are the following:

Railway, from Orchard to Perkins, Idaho, for Oregon Short Line R. R. Co., $3,180,550.

Dormitory, two and three stories, limestone, for Pennsylvania State College, $2,000,000.

Rein.-concrete warehouse for State Board of Harbor Commissioners, San Francisco, Calif., $2,000,000.

Recent Unit-Bids Throughout the Country

Representative unit-bid prices of various materials and operations, applying on several of the more important contracts awarded during the last two months, are shown in the accompanying table.

Cost comparisons, on identical materials or operations in different parts of the country, are depicted in the tabulation. For instance, a rate of 23.4c. per cu.yd. was bid on earth excavation in Waterloo, Ia. as against 40c. in Garden City, Kan.; 70c. in Houston, Tex. and $1 per cu.yd. in Newark, N. J. Structural excavation, however, cost 75c. in Brownsville, Tex. as compared with $1 per cu.yd. in Salt Lake City, Utah. The rate for rock excavation in Utah was $2, with $3 per cu.yd. for the same operation in New Jersey. In wet excavating work, a rate of 25c. per cu.yd was bid on harbor dredging in Providence, R. I.

UNIT-BID PRICES ON IMPORTANT MATERIALS AND OPERATIONS IN RECENT CONTRACTS AWARDED

Where located	Successful Contractor	Date	Nature and Extent of Job	Unit-bid price
Calif., San Diego	California Constr. Co.	Nov. 23	2.2 mi. concrete paving	23,909.09 per mi.
Calif., San Jose	Raisch Improvement Co., San Francisco.	Nov. 2	134,870 sq.ft. 1½ in. asphaltic concrete on 3 in. concrete	0.24 per sq.ft.
			135 sq.ft. concrete gutter	0.24 per sq.ft.
Fla., West Palm Beach	So. Florida Dredging Co., Ft. Lauderdale	Nov. 9	1,430,000 cu.yd. ditching	0.0874 per cu.yd.
Ia., Ft. Madison	Cameron, Joyce & Co., Keokuk	Oct. 26	236,447 cu.yd. clay excavation	0.249 per cu.yd.
Ia., Waterloo	Phelan & Shirley, Omaha, Neb.	Nov. 9	137,143 cu.yd. earth excavation	0.234 per cu.yd.
Kan., Garden City	M. R. Ammerman, Wichita	Nov. 16	2,595 cu.yd. earth excavation	0.40 per cu.yd.
			8,350 cu.yd. borrow	0.35 per cu.yd.
			11,746 sq.yd., 2 course concrete	2.57 per sq.yd.
Kan., Mound City	R. S. Morrow, Omaha, Neb.	Nov. 2	20,871 cu.yd. earth excavation	0.28 per cu.yd.
			182,423 cu.yd. borrow	0.22 per cu.yd.
			268.1 cu.yd. concrete	19.75 per cu.yd.
			17,910 lb. reinforcing steel	0.06 per lb.
Mo., Kansas City	D. T. Brosnahan	Nov. 9	9,129 sq.yd. brick block pavement	3.96 per sq.yd.
			2,462 lin.ft. 6-in. drain tile	0.20 per lin.ft.
Mass., Boston	Lane Construction Co., Meriden, Conn.	Oct. 8	8 mi. bituminous macadam, 16 ft. wide	38,426.88 per mi.
N. J., Newark	Heyman & Goodman Co., Jersey City	Oct. 19	100 cu.yd. earth excavation in tunnel	20.00 per cu.yd.
			8,400 cu.yd. trap rock excavation in tunnel	21.00 per cu.yd.
			16,400 cu.yd. sandstone excavation in tunnel	18.00 per cu.yd.
			30 M. ft. b.m. timber in tunnel	100.00 per M. ft.
			10,900 cu.yd. concrete masonry in tunnel	12.00 per cu.yd.
			13,000 cu.yd. earth excavation in open cut	1.00 per cu.yd.
			11,500 cu.yd. rock excavation in open cut	3.00 per cu.yd.
			750 cu.yd. reinforced concrete	17.00 per cu.yd.
			10 cu.yd. brick masonry	35.00 per cu.yd.
			27,000 bbl. cement	4.00 per bbl.
			48,000 lb. concrete reinforcing steel	0.06 per lb.
			50 cu.yd. sand, gravel and crushed stone	7.00 per cu.yd.
			2,300 lin.ft. vitrified pipe	0.70 per lin.ft.
N. Y., Buffalo	Penn Bridge Co., Beaver Falls, Pa.	Oct. 12	3 dump scows (steel), 400 cu.yd. capacity	30,706.67 each
N. Y., New York	P. J. Kearns Contg. Co.	Nov. 9	4,000 cu.yd. broken trap rock stone	2.93 per cu.yd.
N. Y., New York	Rosoff Sand & Gravel Corp.	Oct. 26	1,000 cu.yd. course aggregate for concrete, delivered on job	2.90 per cu.yd.
O., Canton	Urvan Bros.	Nov. 2	2 mi. monolithic brick paving, 16 ft. wide	34,380.00 per mi.
R. I., Providence	J. S. Packard Dredging Co.	Nov. 9	41,200 cu.yd. harbor dredging	0.25 per cu.yd.
Tex., Brownsville	F. P. McElwrath, Corsicana	Oct. 9	17,431 cu.yd. earth excavation (roadway)	0.16 per cu.yd.
			577 cu.yd. dry structural excavation	0.75 per cu.yd.
			279.94 cu.yd. class "A" concrete, 1:2:4	24.00 per cu.yd.
			26,790 lb. reinforcing steel	0.055 per lb.
			110,650 sq.yd. two-course concrete pavement	2.83 per sq.yd.
Tex., Ft. Worth	McKinsie Constr. Co., San Antonio	Sept. 26	100,000 cu.yd. earth excavation	0.55 per cu.yd.
			100 cu.yd. class "A" concrete	9.50 per cu.yd.
			10,000 lb. steel reinforcing	0.05 per lb.
			10 tons class "A" c.i. pipe	80.00 per ton
Tex., Houston	Smith Bros. Constr. Co., Dallas	Nov. 23	1 mi. bitulithic paving, 40 ft. wide	63,466.00 per mi.
Tex., Marlin	Natl. Cast Iron Pipe & Fdry. Co., Tarrant City, Ala.	Oct. 1	562.5 tons 12-in. c.i. pipe, f.o.b. Marlin	51.00 per ton
Tex., Houston	Smith Bros. Constr. Co., Dallas	Oct. 5	11,000 cu.yd. earth excavation	0.70 per cu.yd.
			32,750 sq.yd. 6-in. concrete base	1.40 per sq.yd.
			13,300 lin.ft. combined curb and gutter	1.00 per lin.ft.
			34,250 sq.yd. asphaltic concrete surface	1.60 per sq.yd.
			34,250 sq.yd. 2-in. rock asphalt surface	1.70 per sq.yd.
Utah, Salt Lake City	Moran Paving Co.	Oct. 10	6,500 cu.yd. solid rock excavation	2.00 per cu.yd.
			68,725 sq.yd. plain concrete paving	1.09 per sq.yd.
Utah Salt Lake City	Gibbons & Reed	Oct. 18	4,416 cu.yd. common excavation	0.80 per cu.yd.
			428 cu.yd. excavation for open drains	0.30 per cu.yd.
			123 cu.yd. structural excavation	1.00 per cu.yd.
			43,238.3 sq.yd. 7½ in. concrete pavement	1.15 per sq.yd.
			31 lin.ft. plain concrete curb and gutter	1.20 per lin.ft.
Wash., Olympic Highway	Ward & Ward, Inc., Tacoma	Oct. 10	138 cu.yd. class "A" concrete	25.00 per cu.yd.
			40,000 lb. reinforcing steel	0.07 per lb.
			353,000 lb. structural steel in place and painted	0.075 per lb.
			4,000 lin.ft. piling	0.50 per lin.ft.
Que., Montreal	Duranceau & Duranceau	Nov. 23	2,000 sq.yd. asphalt paving	5.56 per sq.yd.

and 8.74c. for ditching in West Palm Beach, Fla.

Two-course concrete pavement was laid at a cost of $2.57 in Kansas and $2.83 in Texas. Combined curb and gutter bids were accepted at $1 per lin.ft. in Houston, Tex. and $1.20 in Salt Lake City.

Reinforcing steel rates were as follows: 5@5½c. per lb. in Texas; 6c. in Kansas and New Jersey and 7c. in Washington, delivered at site of job.

Open Shop Rule Governs Building for U. S. Commerce Chamber

Contract for the construction of the new $2,500,000 Washington headquarters of the Chamber of Commerce of the United States has been awarded to James Stewart & Co., of New York. The contract contains a provision that the builders must observe the principle of the "open shop" in the employment of labor.

This item is provided for by the following clause in the specifications:

"The actual construction of the building is to be upon the 'open shop' basis—that is, that union and non-union men shall be employed without discrimination, it being understood that the building committee of the Chamber of Commerce of the United States shall provide such means as in its best judgment shall be impartial and disinterested for prompt review and decision with respect to the interpretation and application of this clause."

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 279 to 290, are the following large projects:

Hospital at Camp Sherman, Chillicothe, O., to Geo. A. Fuller Co., Cleveland, $1,497,000.

A bakery at Philadelphia, Pa., to J. Griffith Sons Co., Chicago, Ill., $1,000,000.

State highways, 50.12 mi., Duluth, Minn., to Butler Bros., St. Paul, $1,369,033.

Two schools, Philadelphia, Pa., to Cramp & Co., $428,562 and $444,297, respectively.

A school at Philadelphia, Pa., to McCloskey & Co., $406,666.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	+$3.35	$3.80	$3.75
Structural rivets, 100 lb.	3.85	4.60	6.00	3.75	4.00	4.80	+4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	4.00	2.92½	3.05	3.85	+3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%¶	53.95%	45%	59½%	57-5%¶	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton.	55.30	+47.50	55.00	51.17	+55.50	63.61	53.00	55.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	—2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	—2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	—36.00	40.00	51.00	39.75	39.75	35.00	+23.50	50.00
Lime, finishing, hydrated, ton.	16.80@ 17.17	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	+18.00@18.55	11.50	9.90	11.00	18@19	12.00	+15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	.0796	.065	....	.11	.09
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	—.90	.97	1.07	.95	1.00	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour.	.60	.35	.....	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour.	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

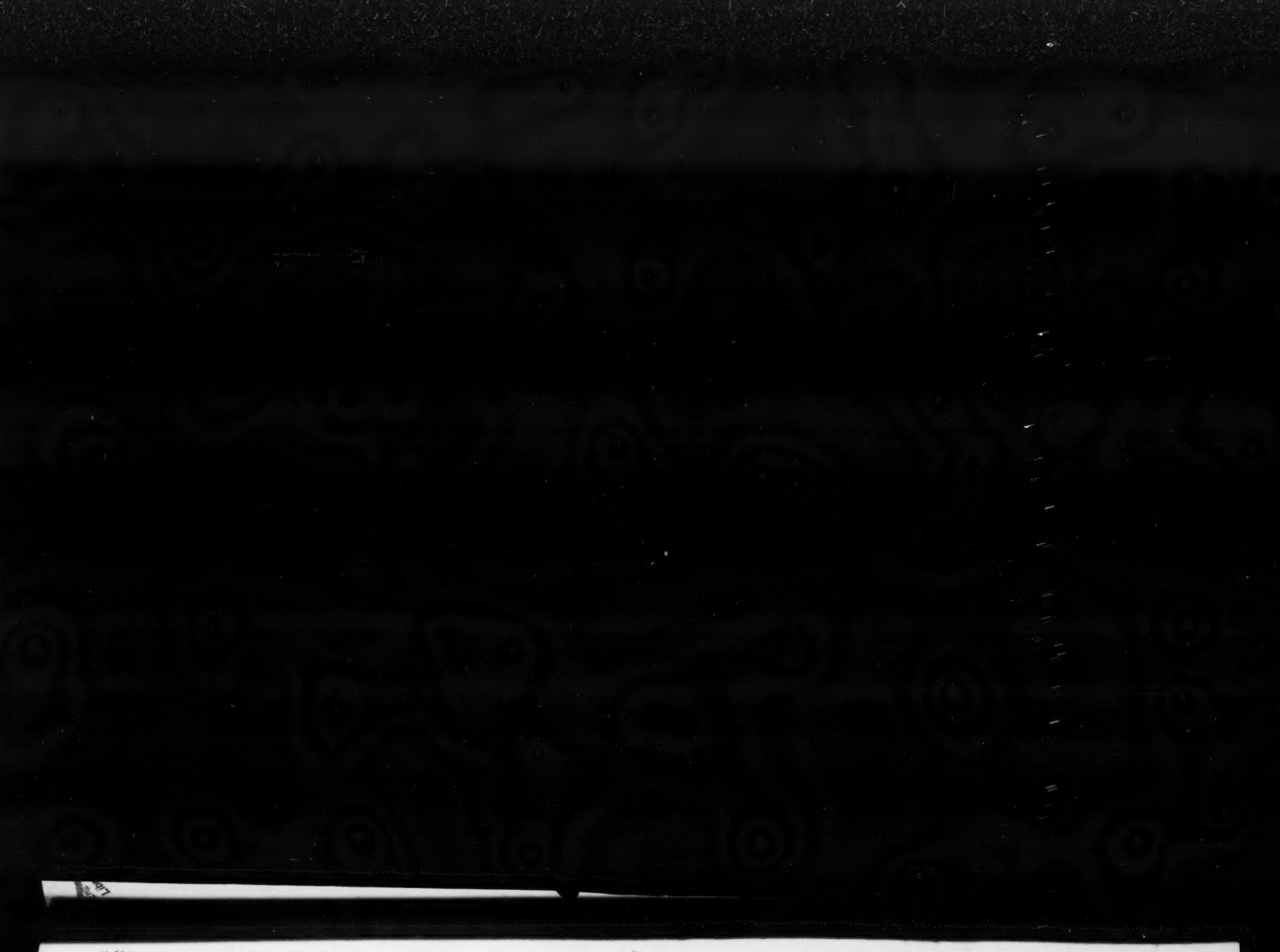
Changes Since Last Week

Although shapes, plates and bars are holding to the $2 level; some mills have shown willingness to cut under this price to the extent of $1@$2 per ton, at mill. Reinforcing bars, however, are quoted at $2.10 per 100 lb., f.o.b. Pittsburgh, for delivering in first quarter of 1923.

San Francisco warehouses advanced shapes and bars to $3.35 per 100 lb., from $3.30, during the week. Rivets are also quoted 25c. per 100 lb., higher. Warehouse prices in other cities continue to show firmness.

Easing of the car situation has caused a reduction of 10c. per cu.yd. in gravel and crushed stone in San Francisco. Prices unchanged in other cities.

Pine lumber dropped $2 per M ft. in Atlanta, during week, while Douglas fir rose $1.50 in Seattle. The chief difficulty in the yellow pine market is shipments of old orders; the car situation being still badly out of line. Slight improvement, however, is reported in some sections.

Common brick quoted at $15@$15.50, alongside dock New York, an advance of 50c.; San Francisco reports $15.50 as compared with $15 per M.

New York quotes raw linseed oil at 90c. per gal. (5 bbl. lots) as against 93c., last week; prices stable elsewhere.